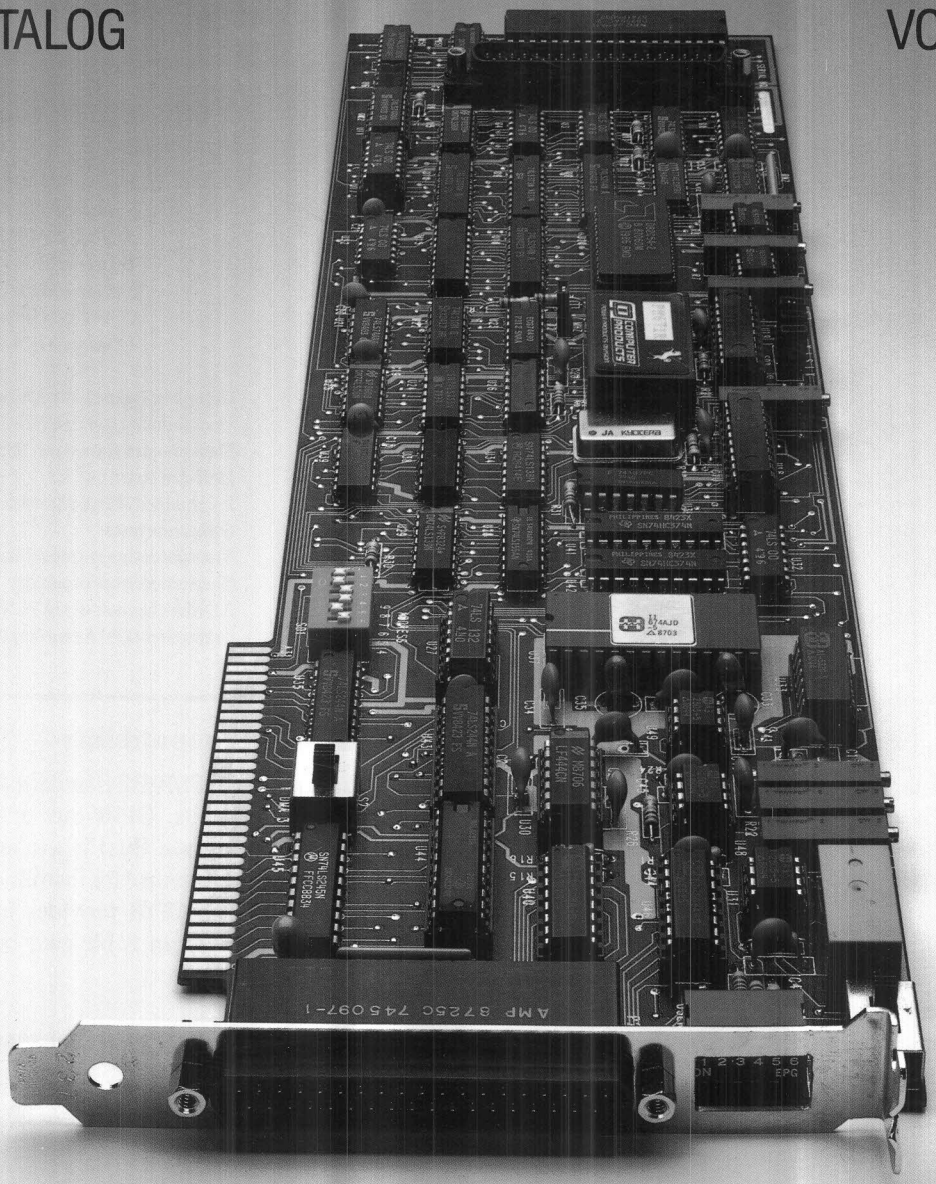
COMPATIBLE I/O SERIES™

CATALOG VOLUME 3

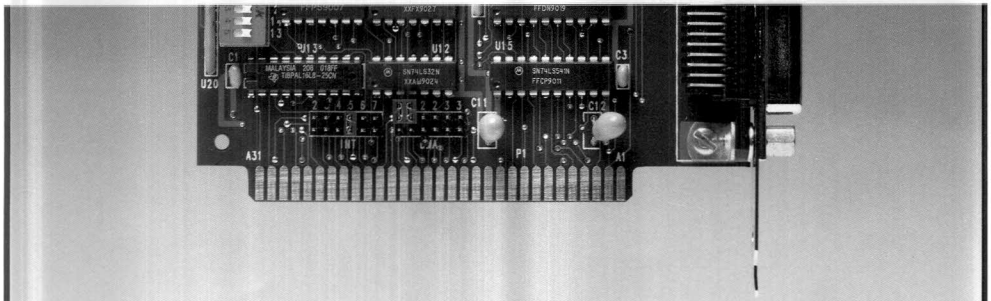


all aboard

44 Wood Avenue
Mansfield, MA 02048

ComputerBoards, INC.

(508) 261-1123
FAX (508) 261-1094



Complete Talker/Listner/Controller
Uses industry standard NEC uPD7210
Data transfer rates over 300K bytes/sec
Half size board
RF shielded IEEE-488 cable connector
6 Interrupt lines
Transparent interrupt enabling/disabling
Sharred interrupt capability
3 DMA channels using PC's DMA controller
Transparent DMA enabling/disabling

DESCRIPTION

The CIO-PC2A IEEE-488 interface converts any PC/XT/AT/386 personal computer into an instrumentation control and data acquisition system. Connect up to 14 instruments using standard IEEE-488 cables such as the C488-2M, 2 meter IEEE-488 interface cable.

The CIO-PC2A is designed around the industry standard NEC uPD7210 GPIB chip. The architecture of the CIO-PC2A board exactly matches that of the National Instruments PCIIA IEEE-488 interface for PCs and compatibles. The PCIIA is the industry standard architecture around which almost all software is designed to operate.

In addition to National Instruments, a number of other well known instrumentation companies have followed the PCIIA architecture. The CIO-PC2A is 100% compatible with all of these products as well.

IEEE-488 (GPIB) Compatibility

The CIO-PC2A adheres to ANSI/IEEE Standard 488-1978. Often refered to as the IEEE-488 bus, GPIB bus or HP-IB bus, the GPIB (**G**eneral **P**urpose **I**nterface **B**us) is a standard for instrumentation communication and control for instruments from manufactures the world over. The GPIB provides handshaking and interface communications over an 8 bit data bus employing 5 control and 3 handshake signals.

Equipped with a CIO-PC2A, a personal computer can:

- Control GPIB instruments.
- Gather data from GPIB test equipment.
- Become a data acquisition station in a GPIB system.

SOFTWARE

The CIO-PC2A does not include software. The NI PCIIA standard has a great quantity and variety of software available through third party vendors. Please respect copyrights and lisences.

SPECIFICATIONS

IEEE-488 Bus Transfer Rates	300K bytes/sec DMA 64K byte block length
Power Requirements	5V @ 0.6A typ., 1.1A max.
Physical Dimesnions	4.2" X 5.0" (0.125 Kg)
Connector	Standard IEEE-488 24 pin
Environmental	0 to 50C @ 85% H. operating -55 to 150C 90% H. storage

ORDERING GUIDE

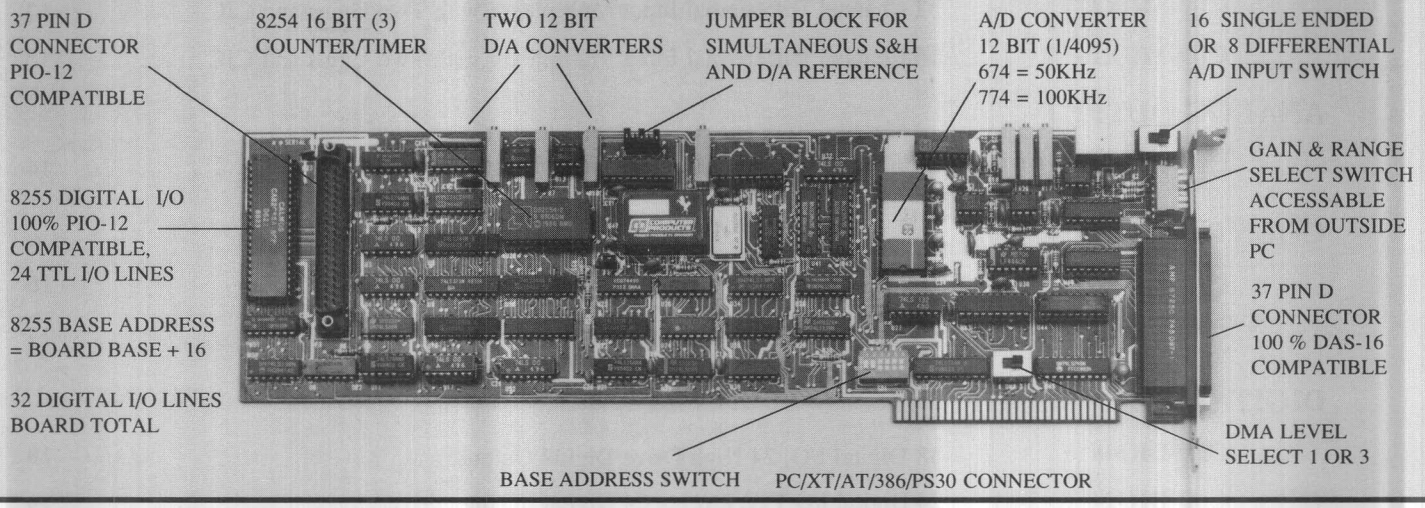
CIO-PC2A IEEE-488 interface board	1 to 9	**$ 125**
	10 to 24	**$ 99**
	25+	**$ 85**
C488-2M 2 Meter IEEE-488 Cable	1 to 9	**$ 59**
	10 to 24	**$ 54**
	25+	**$ 49**

Compatible I/O Series ™ Catalog, Volume 2

Table of Contents

CIO-AD16 & AD16/F

High Speed 16 Channel 12 Bit Analog Input, 2 Channel 12 Bit Analog Output with 32 Digital I/O & 3, 16 Bit Counters



100% DAS-16 COMPATIBILITY GUARANTEED

DESCRIPTION

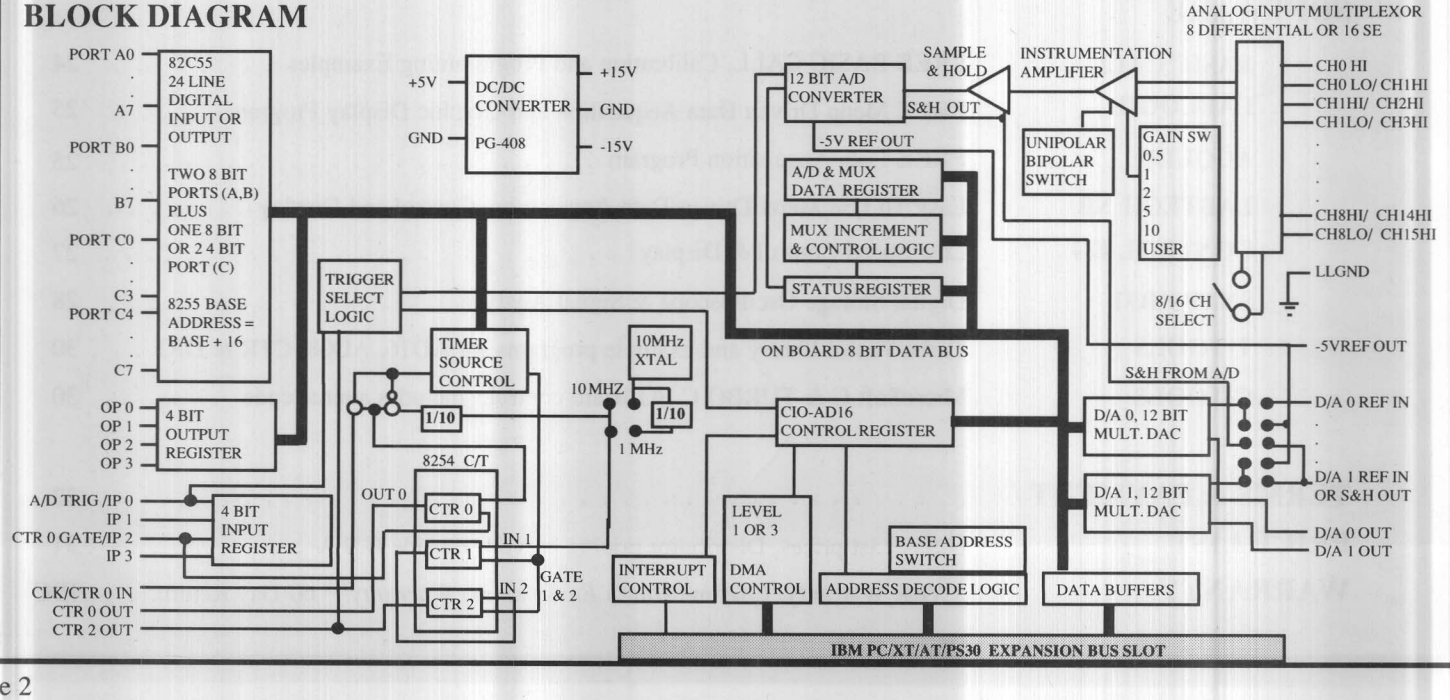
The CIO-AD16 multifunction analog and digital I/O board is designed to be 100% compatible with MetraByte's popular DAS-16 and provide additional features, all at a lower cost.

Installed in any IBM PC/XT/AT/PS30 or compatible computer the CIO-AD16 turns your personal computer into a high speed data acqusition and control station suitable for laboratory data collection, instrumentation, production test, or industrial monitoring.

The CIO-AD16 is supported by a broad range of software to allow programmed control in BASIC, C, FORTRAN and PASCAL. Many menu controlled data logging, analysis and control programs are available from a number of third party developers. In fact, any software designed for MetraByte's popular DAS-16 will work with the CIO-AD16; we guarantee it!

In addition, the CIO-AD16 comes with a complete PIO-12 compatible 8255 and 37 pin connector!

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

ANALOG INPUTS

The analog input section of the CIO-AD16 has been designed for flexibility and accuracy in a number of configurations and ranges. The analog signals are brought on board by a standard 37 pin D connector directly to two multiplexors. The two multiplexors may be configured as 16 channels of single ended input or 8 channels of differential input. Differential inputs can reject noise and ground loops (common mode voltages) but require a 3 wire hookup as opposed to 2. Please see the diagram on the opposite page.
A 2 uSec sample & hold captures the signal which is amplified by 0.5, 1, 2, 5 or 10 times before conversion by a 674 (50KHz) or 774 (100KHz) A/D converter. The 12 bit A/D converter provides a resolution of 1/4095 parts of full scale. Please see the gain and range switch configuration diagram on the opposite page.
The speed of data gathering is dependent on the method of triggering and data transfer, as the table below illustrates.

A/D CONVERSION SPEED

TRIGGER/TRANSFER	PC 4.77 MHz	386/20MHz
Polled/ Transfer to variable	320	2,200
Interrupt/ Variable or array	4,000	20,000
DMA/ CIO-AD16/50K	50,000	50,000
DMA/ CIO-AD16/100K	100,000	100,000

SIMULTANEOUS SAMPLE & HOLD

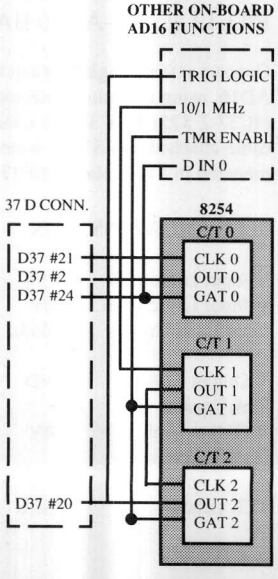
Simultaneous Sample & Hold is an option which allows 16 analog input channels to be triggered simultaneously. This option is important to applications where channel to channel skew is not acceptable, such as audio digitization.

The CIO-AD16 can trigger an external CIO-SSH16 via the unused D/A REF1 input (pin 26, see block diagram). The CIO-SSH16 reduces channel to channel skew from a minmum of 10 uS (CIO-AD16/100K) to zero with less than 50 nS aperture uncertainty.

COUNTER TIMER

The 8254 counter/timer chip has 3 counters of 16 bits each. Much of the 8254 is used by the CIO-AD16 as a pacer clock to synchronize A/D conversions.
One full counter, counter 0, is available for counting, pulse generation or frequency measurement.
The output of counter 2 is available to provide external synchronization to the A/D converter or as a programmable rate source.
If you desire additional counters, a 10 counter CIO-CTR10 is available.

CLK Input Freq. . . . . 10 MHz Max
TTL Loads . . . . . Source 1, Sink 4



ANALOG OUTPUT

Analog voltage output is provided by two 12 bit multiplying D/A converters. This type of converter accepts a reference voltage and provides an output proportional to that. A precision -5V reference from the A/D converter provides an on-board D/A range of 0-5V. Other ranges between +/-10V are possible if you supply a +/-10V external reference at pin #10 or #26 of the 37 pin D connector.

The D/A converters do have program and interrupt transfer capability. Interrupts may be initiated by the on-board pacer clock or by external trigger. The D/A converters do not have DMA transfer capability.

TRIGGERING

A Trigger is the event that begins an acquisition/transfer cycle. There are three ways to trigger a CIO-AD16; software, internal or external. There are also three ways to transfer data from the CIO-AD16; program, interrupt service routine or DMA.

An internal trigger is useful for synchronizing samples to a known time base; the on board XTAL and 8254 programmable divider. Using an external trigger allows you to synchronize samples to an external event.

I/O & CONTROL REGISTER MAP

The CIO-AD16 and MetraByte DAS-16 are 100% software compatible because the I/O register have identical functions on each board. I/O registers are the locations to which the computer writes commands and data and from which reads status and data from.

I/O ADDR.	CIO-AD16 FUNCTION R-W	I/O ADDR.	CIO-AD16 FUNCTION R - W
BASE + 0	A/D Low Byte - Start A/D	BASE + 8	A/D Status - NA
BASE + 1	A/D High Byte - NA	BASE + 9	Control Settings - Control
BASE + 2	Mux Settings - Mux Scan Control	BASE + 10	NA - Counter Source Control
BASE + 3	Digital 4 In - Digital 4 Out	BASE + 11	Not Used
BASE + 4	NA - D/A0 Low Byte Out	BASE + 12	Counter 0 - Counter 0 Load
BASE + 5	NA - D/A0 High Byte Out	BASE + 13	Counter 1 - Counter 1 Load
BASE + 6	NA - D/A1 Low Byte Out	BASE + 14	Counter 2 - Counter 2 Load
BASE + 7	NA - D/A1 High Byte Out	BASE + 15	NA - 8254 Counter Control
	CIO-AD16 8255 FUNCTION R - W		CIO-AD16 8255 FUNCTION R-W
BASE + 16	Port A In - Port A Out	BASE + 18	Port C In - Port C Out
BASE + 17	Port B In - Port B Out	BASE + 19	NA - 8255 Control

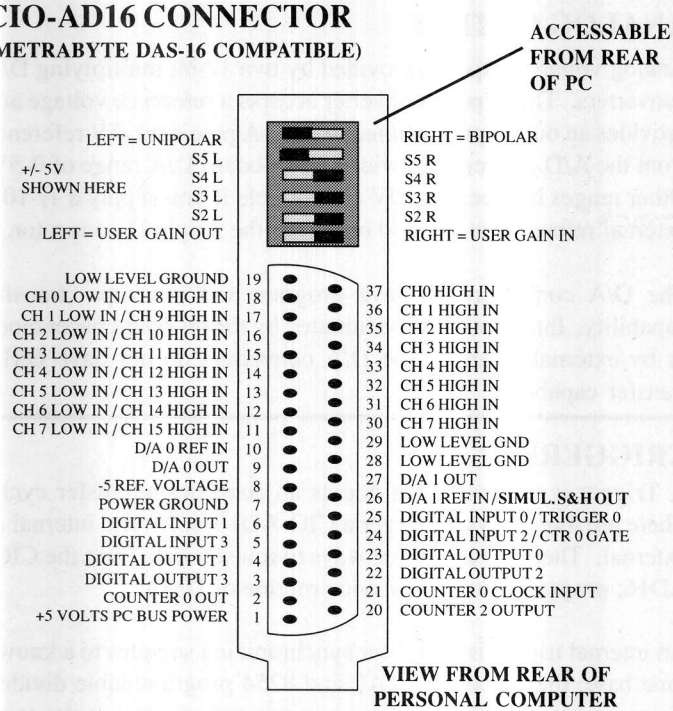
A/D SPECIFICATIONS — 12 BIT

Channels	16 SE or 8 Differential
A/D Type	Successive Approx. AD74 Series
Conversion Time	8.5 uS 774, 15 uS 674
A/D Convert & Transfer Speed (DMA)	100KHz AD16/F, 50KHz AD16
Accuracy	0.01% +/- 1 LSB
Integral Linearity	+/- 1 LSB
No missing codes guaranteed over temp. range.	
Maximum Overvoltage	+/- 35V Continuous
Input Leakage Current	250 nA Max @ 25°C
Gain Drift	+/- 25 ppm/Deg C Max
Zero Drift	+/- 10 ppm/Deg C Max

D/A SPECIFICATIONS — 12 BIT

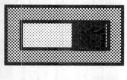
Channels	2
D/A Type	Multplying 4 Quadrant
Conversion Time	30nS to 0.01%
Integral Lineraity	+/- 1/2 LSB
Differential Linearity	+/- 1/2 LSB
Reference Range	+/- 10V
Outpur Range	+/- 10V, Reference dependent
R Out	0.1 Ohm Max
I Out	+/- 5mA Min

CIO-AD16 CONNECTOR
(METRABYTE DAS-16 COMPATIBLE)

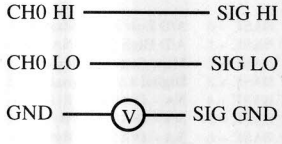


8 / 16 CHANNEL SWITCH

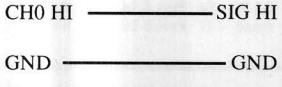
A switch on the CIO-AD16 configures the analog inputs as either 8 channels of differential input or 16 channels of single ended input.



DIFFERENTIAL INPUT IS A 3 WIRE ANALOG CONNECTION WHICH IS LESS SUSCEPTABLE TO NOISE AND GROUND LOOPS.

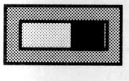


SINGLE ENDED INPUT IS A 2 WIRE ANALOG CONNECTION WHICH IS FINE FOR MOST APPLICATIONS.



DMA LEVEL SELECT

The CIO-AD16 can use DMA levels 1 or 3, providing full compatibility with PC/ XT/AT/PS30.

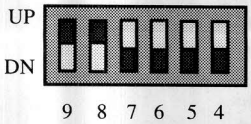


BASE ADDRESS SELECTION

The CIO-AD16 is addressed through software at an I/O address set by the switch shown here. The switch selects the first or BASE address. Switches have values in the down position. Values are added.

SW No.	HEX VALUE	DECIMAL VALUE	Example
A9	200	512	512
A8	100	256	+ 256
A7	80	128	+ 0
A6	40	64	+ 0
A5	20	32	+ 0
A4	10	16	+ 0
			= 768

BASE ADDRESS IS SET FOR 300 HEX, 768 DEC.



GAIN & RANGE SELECTION

Six range & gain combinations including one user selectable gain are provided by selecting options from the gain & range switches, as seen in the diagram to the left.

The gain & range switches are all accessible from the outside of the computer through a cut-out in the mounting bracket.

SWITCH POSITION

S1	S2	S3	S4	S5	GAIN	BIPOLAR S6=RIGHT	UNIPOLAR S6=LEFT	RESOLUTION
L	L	L	L	L	0.5	+/- 10V	N/A	4.88 mV / BIT
L	L	L	L	R	1	+/- 5V	0 - 10 V	2.44 mV / BIT
L	L	L	R	R	2	+/- 2.5V	0 - 5 V	1.22 mV / BIT
L	L	R	L	R	5	+/- 1V	0 - 2 V	0.488 mV / BIT
L	R	L	L	R	10	+/- 0.5V	0 - 1 V	0.244 mV / BIT
R	L	L	L	R	0.5<U<20	USER	USER	SEE EQUATION

USER SUPPLIED GAIN: You may install a resistor on the CIO-AD16 and provide a custom gain that exactly matches your application. There are limits to the achievable gain. The limits, and the formula for selecting a resistor are supplied here.

USER GAIN EQUATION:

$$R_{USER} = \frac{20{,}000 * V_{FS}}{(10 - V_{FS})}$$

USE THIS EQUATION TO SELECT THE CORRECT RESISTOR FOR A SPECIFIC FULL SCALE RANGE.

EXAMPLE: FOR A RANGE OF 0 TO 0.5V_{FS} (+/- 0.25V BIPOLAR) THE CALCULATED RESISTOR IS 1053 OHMS.

$$V_{FS} = \frac{10 * R_{USER}}{R_{USER} + 20{,}000}$$

USE THIS EQUATION TO DETERMINE THE RANGE FOR THE RESISTOR YOU HAVE.

V_{FS} = THE FULL SCALE UNIPOLAR VOLTAGE RANGE. FOR BIPOLAR DIVIDE V_{FS} BY 2 AND ADD +/-.

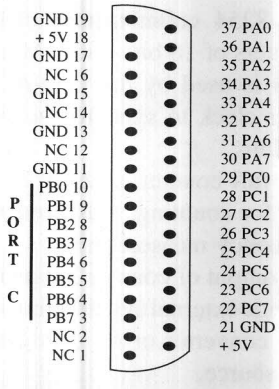
MAX RANGE = 0 TO 10V UNI, +/- 10V BIP :: **MIN RANGE** = 0 TO 0.5V UNI, +/- 0.25V BIP

24 BIT DIGITAL I/O CONNECTOR
(METRABYTE PIO-12 COMPATIBLE)

A 37 Pin D type connector, mounted on the CIO-AD16 board is the connector for a PIO-12 compatible 24 line bi-directional digital I/ O port. The 8255 on board raises the digital I/O count to 32 lines. The 8255 BASE address is located at CIO-AD16 BASE address + 16. To access the 8255 from a menu driven program just install a PIO-12 at CIO-AD16 BASE + 16!

Connect external digital signals to the CIO-AD16 using a 37 pin connector and cable (#C37-2 $25) or a 37 pin connector and cable attached to a 37 pin male connector mounted in a backplate (#BP37 $25).

SPECIFICATIONS	MIN	MAX
V Input Logic Low	-0.5V	0.8V
V Input Logic High	2.0V	5.0V
Input Load Current	-10uA	10uA
V Output Low	GND	0.45V
Sink Current		1.7mA
V Output High	2.4V	
Source Current		200uA
TTL Loads	1 SRC	4 SNK

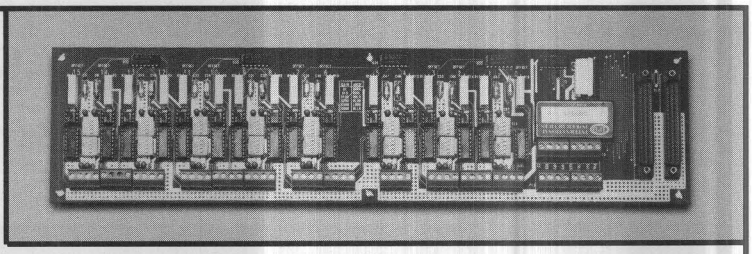


VIEW FROM COMPONENT SIDE OF CIO-AD16

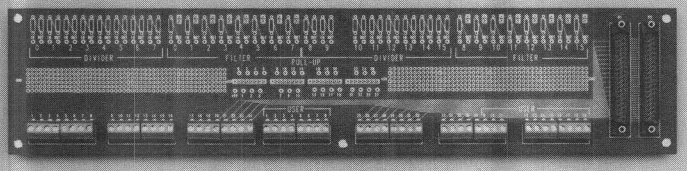
SIMULTANEOUS SAMPLE & HOLD

Capture 16 channels simultaneously with less than 50 nSec of aperture uncertainty at 100KHz. The CIO-SSH16 simultaneous sample & hold accessory expands the CIO-AD16's 16 single ended, multiplexed inputs into 16 fully differential inputs with individual, switch selectable gains of up to 800 on every channel. The 16 sample & holds are triggered by the CIO-AD16 once per scan as fast as the CIO-AD16 will go.

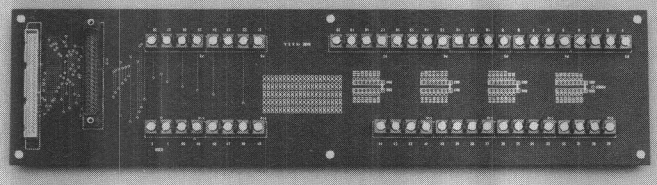
The CIO-SSH16 is triggered by a CIO-AD16 track & hold pulse which is generated by the CIO-AD16 on every scan. No software modifications are required to realize the benefits of simultaneous sample & hold. Just drop a CIO-AD16 and CIO-SSH16 into your existing DAS-16 application. Fire up the software you've been using all along and start collecting data from simultaneous samples.



An excellent addition to audio, vibration or other multi-channel spectrum analysis applications. The cost per channel is the lowest in the industry and the performance is guaranteed.



CIO-TERMINAL



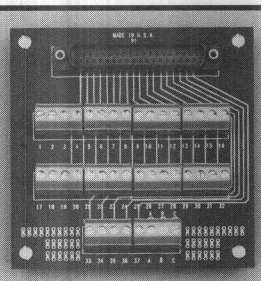
CIO-SPADE50

SCREW TERMINAL ACCESSORIES

Screw terminal boards accept 12-22 AWG wire or spade lugs. The CIO-TERMINAL provides prototype area, pull up resistor, filter and divider circuitry you can populate.

The CIO-SPADE50 has tough spade lugs in a 16" X 4" form factor for easy NEMA cabinet or rack mounting. A good termination panel for industrial applications.

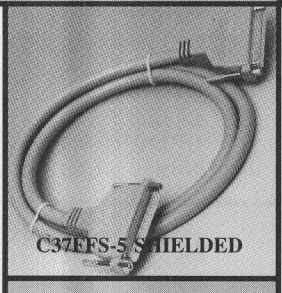
The CIO-MINITERM is the most compact and economical terminal board available. Forty screw terminals provide access to all 37 CIO-AD16 signals plus 4 spares. Two small proto areas are just enough for an op-amp or a few passives.



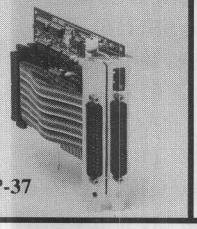
CIO-MINITERM

CABLES & CONNECTORS

Highest quality cables and connectors of all lengths are available from stock. The CIO-AD16 has male 37 D connectors as do the accessory and screw terminal boards. The cables which mate A/D board to screw terminal are terminated with 37 D female connectors at each end. Shielded cables of 5 and 10 feet and ribbon cables of all lengths are available.



C37FFS-5 SHIELDED



BP-37

The BP37 brings signals from internal connectors to the rear of the PC, where a standard cable joins the BP37 to accessory boards. The BP37 is shown here with a CIO-AD08.

C37FF-2 RIBBON

ORDERING GUIDE

CIO-AD16 comes in two speeds.	
50 KHz Max Analog Input	CIO-AD16
100 KHz Max Analog Inout	CIO-AD16/F
Sample & Hold Accessory	
16 Ch. S&H Diff. Amp accessory board, 4 Ch. installed.	CIO-SSH16
Additional S&H + Amps installed. Up to 12 additional.	CIO-SSH-AMP
Screw Terminal Boards	
16" X 4" all signals from one 37 D plus proto area & circuitry.	CIO-TERMINAL
4" X 4" all signals from one 37 D connector.	CIO-MINITERM
16" X 4" all signals from one 37D, Spade Lug Terminals.	CIO-SPADE50
Cables	
2 foot ribbon cable, 37 conductor, female connectors.	C37FF-2
'N' foot ribbon cable, 37 conductor, female connectors.	C37FF-N
5 foot shielded cable, molded female connectors, 37 cond.	C37FFS-5
10 foot shielded cable, molded female connectors, 37 cond.	C37FFS-10

FREE CALL ROUTINE & PROGRAMS

The CIO-AD16 software package is one of the most extensive free packages in the industry. A BASIC CALL library supports programming of all the AD16's functions. Calibration and test programs keep the AD16 in top form. Lablog II and ACQUIRE are menu driven, easy to use and completely *FREE* with every AD16.

PLEASE TURN TO PAGES 24 & 25 FOR A COMPLETE DESCRIPTION

THIRD PARY SOFTWARE SUPPORT

ASYST
Asystant+
Control EG
LabTech Notebook
LabTech Control
Paragon Control
Snapshot Storage Scope
Streamer
TTOOLS
Unkelscope

PLEASE TURN TO PAGES 24 - 30 FOR THESE PRODUCTS

CIO-SSH16

16 Channel Simultaneous Sample & Hold Accessory Board

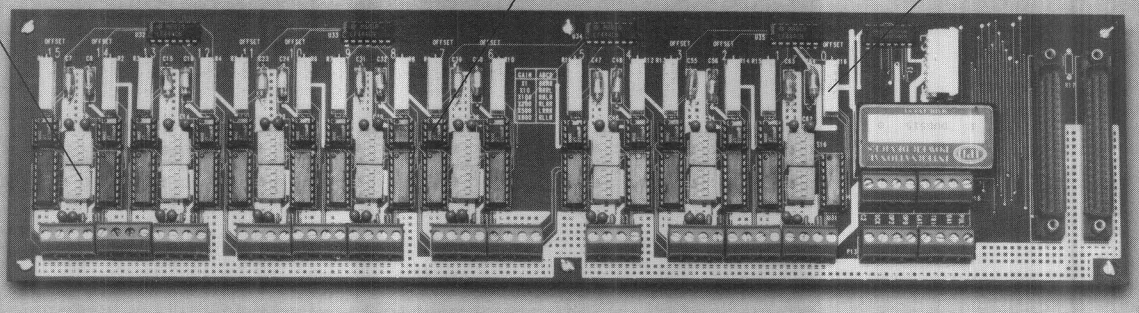
16 DIFFERENTIAL INPUTS

INDIVIDUAL SWITCH SELECTABLE GAINS OF:
1
10
100
200
300
500
600
700 &
800

16 SAMPLE & HOLD AMPLIFIERS. LESS THAN 50 NANOSECONDS APERATURE UNCERTAINTY

EACH CHANNEL IS INDIVIDUALLY CALIBRATED

CALIBRATION SOFTWARE INCLUDED



37 PIN D TYPE CONNECTOR MATES WITH ALL CIO-AD ANALOG INPUT BOARDS

FULLY SUPORTED BY BASIC CALL SOFTWARE AND THIRD PARTY SOFTWARE DUE TO AUTOMATIC, HARDWARE TRIGGERING.

SCREW TERMINALS FOR 12-22 AWG

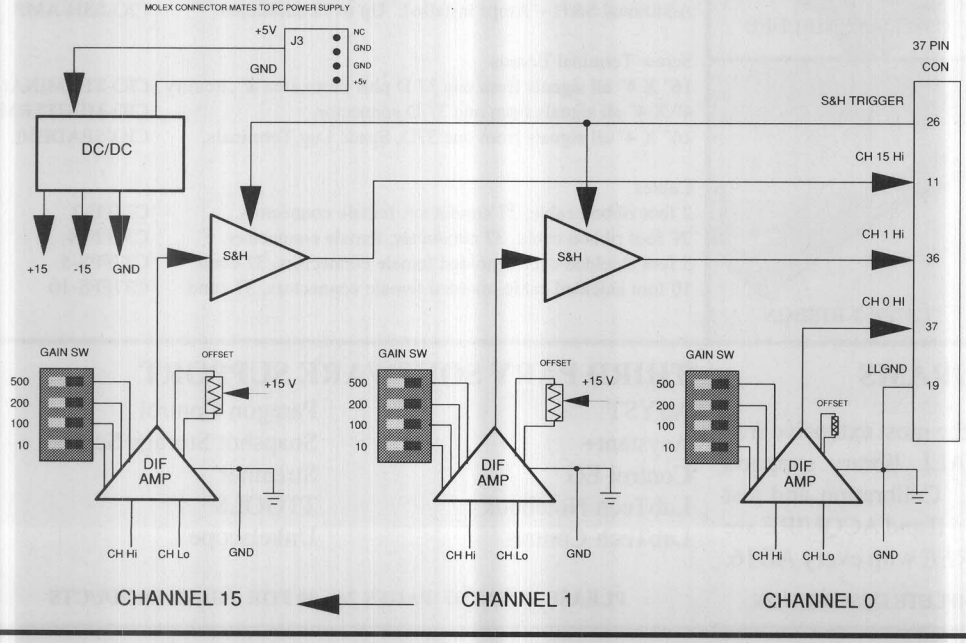
DESCRIPTION

The CIO-SSH16 simultaneous sample and hold accessory acts as a front end signal amplification and capture for the CIO-AD16 series of analog input boards.

There are two major functions on the board. Sixteen differential amplifiers have individual switch selectable gains of 1, 10, 100, 200 , 300, 500, 600, 700 and 800 providing very flexible amplification of individual signals. After amplification, each channel has a sample and hold which is controlled by the CIO-AD analog input board. The total aperture uncertainty for all 16 circuits is less than 50 nanoseconds.

The CIO-SSH16 eliminates the channel to channel skew associated with multiplexed A/D inputs. A fast A/D board sampling at 100,000 samples per second will exhibit a minimum channel to channel skew of 10 microseconds. Since the skew is additive from channel to channel, the 16 channel total scan skew is 160 micro seconds. In applications where a number of signals must be analyzed and compared, such as high speed transient analysis and spectrum analysis, a channel to channel skew may be unacceptable.

Even low speed applications, such as oscillographic recording and display may require simultaneous sampling of all channels.



BLOCK DIAGRAM

There are 16 separate fully differential amplification and sample & hold circuit blocks on the SSH16. One block, channel 0, uses the sample & hold chip on the CIO-AD16. The S&H Trigger line enters TRACK whenever the CIO-AD16 enters TRACK on channel 0. When the CIO-AD16 enters HOLD for channel 0 the entire SSH16 enters HOLD also. The SSH16 remains in HOLD mode while the CIO-AD16 samples channles 1, 2, 3 ...N. All SSH16 acquisition runs begin with channel 0 and by taking advantage of the CIO-AD16 S&H chip, the A/D conversion and transfer rate equals the maximum throughput of the AD16.

SAMPLE & HOLD TRIGGER

The signal, S&H Trigger, from the CIO-AD16 controls the mode of the LF398 TRACK/HOLD chips on the SSH16. When T/H is high, all the LF398 chips track the analog signal on the SSH16 inputs. 200 nanoseconds after the T/H signal goes low, all the LF398s have settled and are holding a constant output voltage. The LF398s continue to hold a stable output voltage until the T/H signal once more enters TRACK.

USED WITH THE CIO-AD16

The SSH16 is designed to be used as an amplification and sample & hold accessory for the CIO-AD16. The CIO-AD16 signal, S&HOUT (pin 26) , synchronizes the LF398 sample & hold chips to the CIO-AD16. The control signal is hardware generated so any CIO-AD16 software works with the CIO-SSH16.

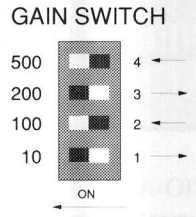
EACH CHANNEL HAS A GAIN AMPLIFIER

INPUT GAIN SWITCH

The input gain switch controls the amplification level of the INA110 differential input amplifier. Each switch controls one gain weight and weights are additive. Shown to the right is a gain of 500 + 100 = 600.

When all switches are to the right (off) the amp is at unity gain.

In addition, the CIO-AD16 gains are multiplicative with the CIO-SSH16.



SPECIFICATIONS

CHANNELS	16
Differential Amplifier	INA110
Gain Weights	1,10,100,200,500
Sample & Hold Chip	LF398
Aperture Time (Max.)	250 nSec
Aperture Time (Avg.)	175 nSec
Aperture Uncertainty	+/- 25 nSec
Acquisition Time (Max.)	10 uSec
Droop Rate	+/- 100 uVolts/ mSec
Noise RMS 10KHz - 100KHz	10 uVolts
Accuracy	0.01% of reading +/- 1 bit
Power Consumption (Max.)	5.9 Watts

ORDERING GUIDE

CIO-SSH16 Main board with 4 channels installed.	CIO-SSH16
One additional channel of amp and S&H. 12 may be added for a total of 16 channels on board.	CIO-SSH-AMP

NOTE: Additional channels of amplification and sample & hold may be ordered with the CIO-SSH16 and installed by the factory, or, ordered later and installed by you. Please specify installed or un-installed CIO-SSH-AMPs when you order.

Cable, shielded round cable with molded connectors, 5 ft.	C37FFS-5
Cable, shielded round cable with molded connectors, 10 ft.	C37FFS-10

This shielded cable will provide a noise free signal path from your CIO-SSH16 to your CIO-AD16.

SUPERIOR TO PROGRAMMABLE GAIN

Programmable gain allows you to select a unique gain/range for every channel and to control the gain under software. A complete amplifier on every channel provides the same flexibility and superior performance. Here is why.

CALIBRATION: The A/D board should be calibrated for the one range it will be operated in. Each channel of the CIO-SSH16 can be calibrated for the range you want to gather data in. An A/D board with programmable gain can be calibrated for only one range at a time.

SPEED: Amplifying the input to the A/D should not limit the maximum A/D sample rate. The CIO-SSH16 will sample at the maximum A/D throughput even at maximum gain of 800. Checking the specifications of any programmable gain A/D board shows that the throughput limitations at high gains are often severe.

FLEXIBILITY: Each channel should support a different gain even at DMA speeds. The CIO-SSH16 supports a different gain on every channel regardless of data transfer method. Many PGA A/D boards must remain in a single range during DMA operations. Those that are that flexible are also expensive, costing more than a CIO-AD16 and CIO-SSH16 combination, and do not include simultaneous sample & hold.

SOFTWARE

The CIO-AD16 and CIO-SSH16 combination are supported by:

ASYST	Paragon Control
Asystant+	Snapshot Storage Scope
Control EG	Streamer
LabTech Notebook	TTOOLS
LabTech Control	UNKEL Scope

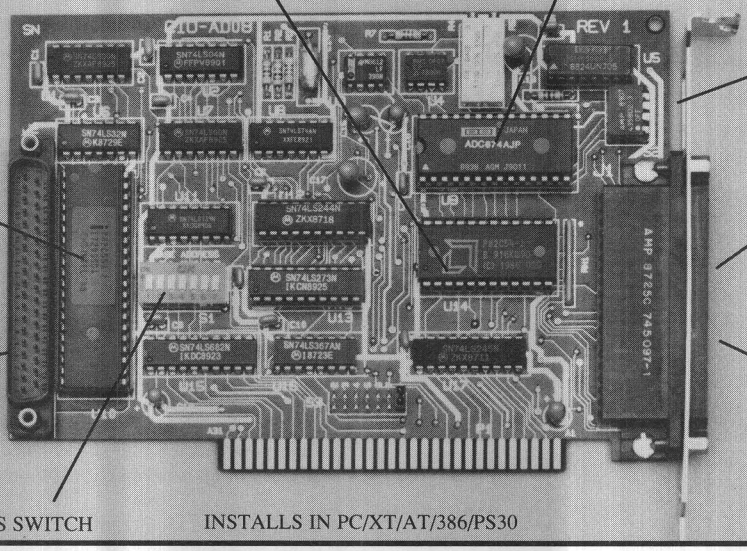
Any software which supports the CIO-AD16 (or MetraByte DAS-16) automatically supports the simultaneous sample & hold features of the CIO-AD16 and CIO-SSH16.

Sample and hold triggering is done by hardware and does not require any new software, or modifications to existing software. The trigger occurs on each A/D scan. A CIO-SSH16 installed as an analog signal conditioning accessory to your CIO-AD16 indicates your intention that all channels be triggered simultaneously. No further set-up or programming is required.

The CIO-AD16 and CIO-SSH16 combination is the perfect upgrade to any outdated DAS-16 applications that would benefit from simultaneous sample & hold or superior gain and range on every channel. No reprogramming of your application code, whether written in ASSEMBLY, C or BASIC will be required!

CIO-AD08

Medium Speed, 8 Channel Analog Input, 3 Counters, 31 Digital I/O



DESCRIPTION

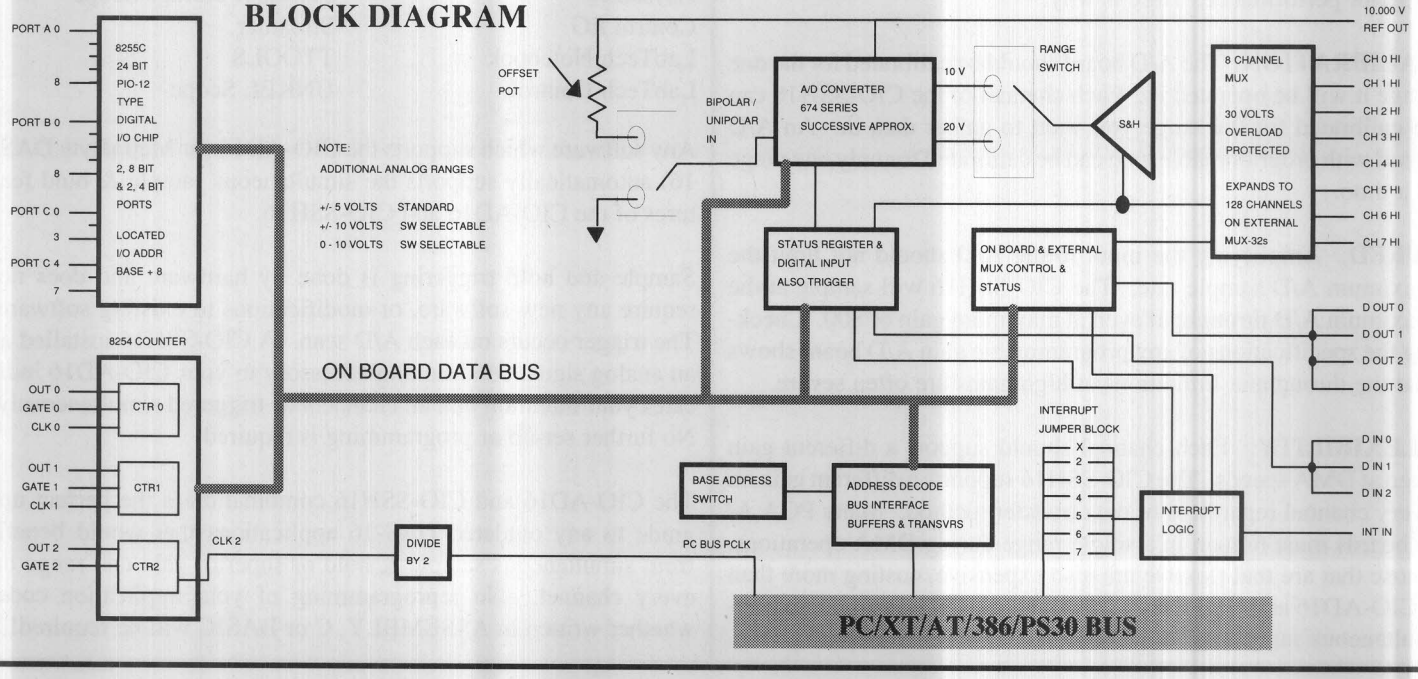
The CIO-AD08 multifunction analog and digital I/O board is designed to be 100% compatible with MetraByte's popular DAS08 and provide additional features, all at a lower cost.

Installed in any IBM PC/XT/AT/PS30 or compatible computer the CIO-AD08 turns your personal computer into a medium speed data acqusition and control station suitable for laboratory data collection, instrumentation, production test, or industrial monitoring.

The CIO-AD08 is supported by a broad range of software to allow programmed control in BASIC, C, FORTRAN and PASCAL. Many menu controlled data logging, analysis and control programs are available from a number of third party developers. In fact, any software designed for MetraByte's popular DAS-08 will work with the CIO-AD08; we guaranty it!

In addition, the CIO-AD08 comes with a complete PIO-12 compatible 8255 and 37 pin connector!

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

ANALOG INPUTS

The analog input section of the CIO-AD08 has been designed for flexibility and accuracy in a number of configurations and ranges. The analog signals are brought on board by a standard 37 pin 'D' type connector directly to an analog multiplexor. The multiplexor provides 8 channels of single ended input and is protected against 30 volts max.

A 2 uSec sample & hold captures the signal which is converted by a 674 A/D converter. The 12 bit A/D converter provides a resolution of 1/4095 parts of full scale. Please see the gain and range switch configuration diagram to the right.

The speed of data gathering is dependent on the method of triggering and data transfer, as the table below illustrates.

A/D CONVERSION SPEED TRIGGER/TRANSFER	CLOCK PC 4.77 MHz	CLOCK 386/20MHz
Polled/ Transfer to variable	320	2,200
Interrupt/ Variable or array	4,000	20,000

A/D SPECIFICATIONS

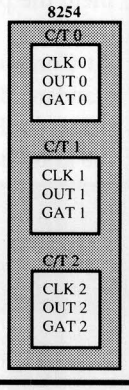
	12 BIT
Channels	8 Single Ended
A/D Type	Successive Approx. AD674
Conversion Time	15 uS
Accuracy	0.01% +/- 1 LSB
Integral Linearity	+/- 1 LSB
No missing codes guaranteed over temp. range.	
Maximum Overvoltage	+/- 35V Continuous
Input Leakage Current	250 nA Max @ 25°C
Gain Drift	+/- 25 ppm/Deg C Max
Zero Drift	+/- 10 ppm/Deg C Max

COUNTER TIMER

An 8254 counter/timer chip on the CIO-AD08 provides a means to generate pulses, count events, measure frequency and pace the analog input trigger.

The 8254 chip has three 16 bit counters arranged as a CLK input, a Gate which allows or inhibts the CLK input and an OUT, the pulse rate of which is a function of the divisor and the mode of operation.

CLK Input Freq. . . . . 10 MHz Max
TTL Loads . . . . . Source 1, Sink 4



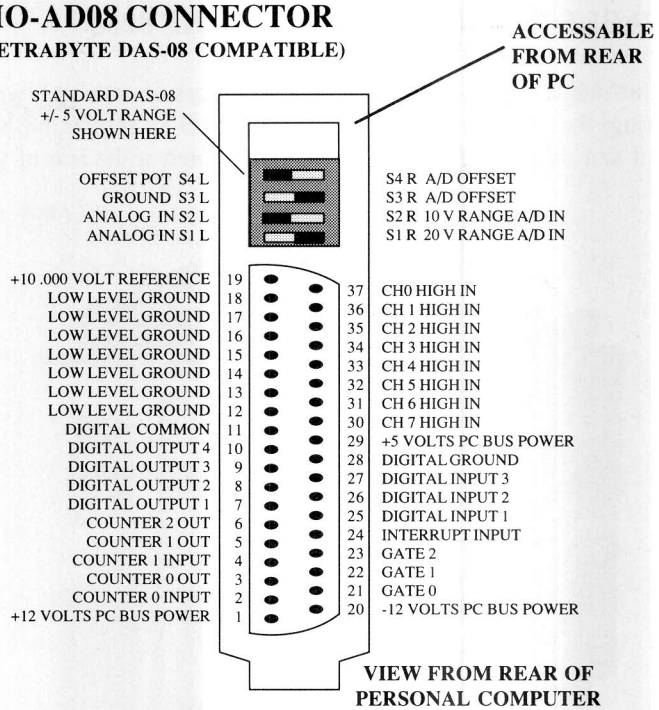
I/O & CONTROL REGISTER MAP

The CIO-AD08 and MetraByte DAS-08 are 100% software compatible because the I/O register have identical functions on each board. I/O registers are the locations which the computer writes commands and data to and reads status and data from.

I/O ADDR.	CIO-AD08 FUNCTION R | W	I/O ADDR.	CIO-AD08 8255 FUNCTION R | W
BASE + 0	A/D Low Byte | Start A/D	BASE + 8	Port A In | Port A Out
BASE + 1	A/D High Byte | NA	BASE + 9	Port B In | Port B Out
BASE + 2	Mux Settings | Mux Scan Control	BASE + 10	Port C In | Port C Out
BASE + 3	Not Used	BASE + 11	NA | 8255 Control
BASE + 4	Read Counter 0 | Load Counter 0		
BASE + 5	Read Counter 1 | Load Counter 1		
BASE + 6	Read Counter 2 | Load Counter 2		
BASE + 7	Not Used | Counter Control		

CIO-AD08 CONNECTOR

(METRABYTE DAS-08 COMPATIBLE)



RANGE SELECTION

Three range combinations are provided by selecting options from the gain & range switches, as seen in the diagram to above. Ranges +/- 5v and 0-10 volts provide 2.44 mV per bit; +/-10V range has a resolution of 4.88 mV per bit.

SWITCH	+/-5V	+/-10V	0-10V	NOTE:
S4	R	R	L	Positions other than those
S3	L	L	R	shown to the left are unde-
S2	R	L	R	fined and will not produce
S1	L	R	L	valid results

TRIGGERING

A Trigger is the event that begins an acquisition/transfer cycle. There are three ways to trigger a CIO-AD08; software, internal or external. There are two ways to transfer data from the CIO-AD08; program or interrupt service routine.

An internal trigger is useful for synchronizing samples to a known time base, such as the on board 8254 programmable divider and PC Bus Peripheral Clock signal . Using an external trigger allows you to synchronize samples to an external event.

BASE ADDRESS SELECTION

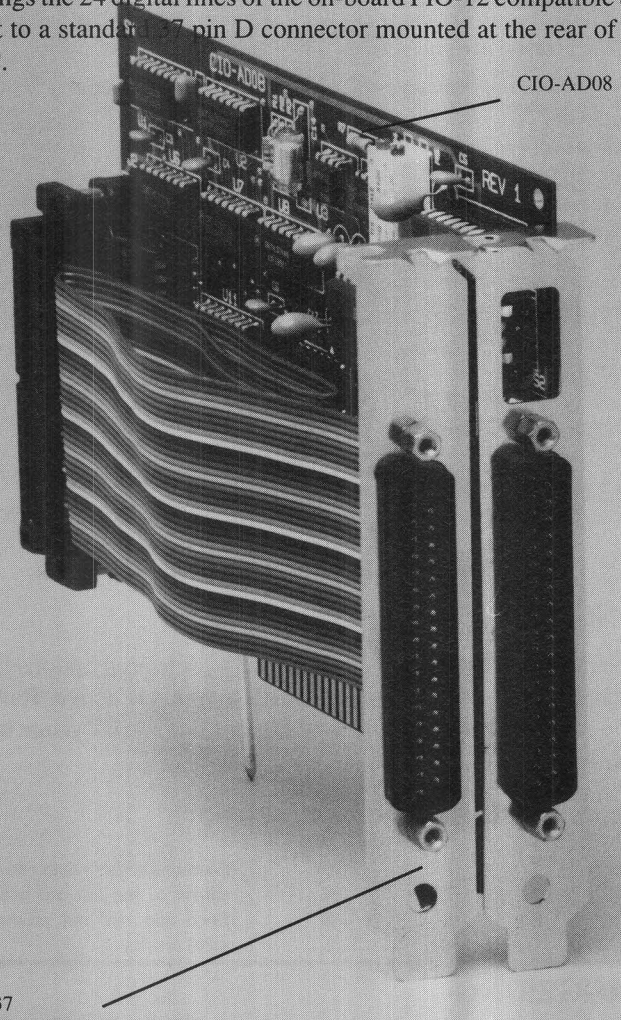
The CIO-AD08 is addressed through software at an I/O address set by the switch shown here. The switch selects the first or BASE address. Switches have values in the down position. Values are added.

SW No.	HEX VALUE	DECIMAL VALUE	Example
A9	200	512	**512**
A8	100	256	+ **256**
A7	80	128	+ **0**
A6	40	64	+ **0**
A5	20	32	+ **0**
A4	10	16	+ **0**
			= **768**

BASE ADDRESS IS SET FOR 300 HEX, 768 DEC.

CABLE & CONNECTION TO THE 8255

Illustrated below is the BP37 cable and backplane connector which brings the 24 digital lines of the on-board PIO-12 compatible 8255 out to a standard 37 pin D connector mounted at the rear of your PC.



CIO-AD08

BP37
INCLUDES BACKPLATE
CABLE & CONNECTORS
BRINGS PIO-12 DIGITAL I/O TO REAR OF PC

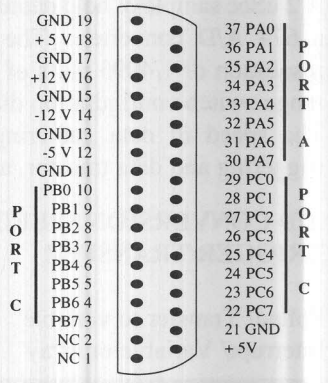
24 BIT DIGITAL I/O CONNECTOR

(METRABYTE PIO-12 COMPATIBLE)

A 37 Pin D type connector, mounted on the CIO-AD08 board is the connector for a PIO-12 compatible 24 line bi-directional digital I/O port. The 8255 on board raises the digital I/O count to 32 lines. The 8255 BASE address is located at CIO-AD08 BASE address + 8. To access the 8255 from a menu driven program just install a PIO-12 at CIO-AD08 BASE + 8.

Connect external digital signals to the CIO-AD08 using a 37 pin connector and cable (#C37FF-2) or a 37 pin connector and cable attached to a 37 pin male connector mounted in a backplate; BP37.

SPECIFICATIONS	MIN	MAX
V Input Logic Low	-0.5V	0.8V
V Input Logic High	2.0V	5.0V
Input Load Current	-10uA	10uA
V Output Low	GND	0.45V
Sink Current		1.7mA
V Output High	2.4V	
Source Current		200uA
TTL Loads	1 SRC	4 SNK



VIEW FROM COMPONENT SIDE OF CIO-AD08

WARRANTY & SUPPORT

A Three Year Warranty, lifetime *Harsh Environment Warranty*™, and 60 Day No-Questions-Asked return protect your investement in a *Compatible I/O Series*™ data acquisition board.

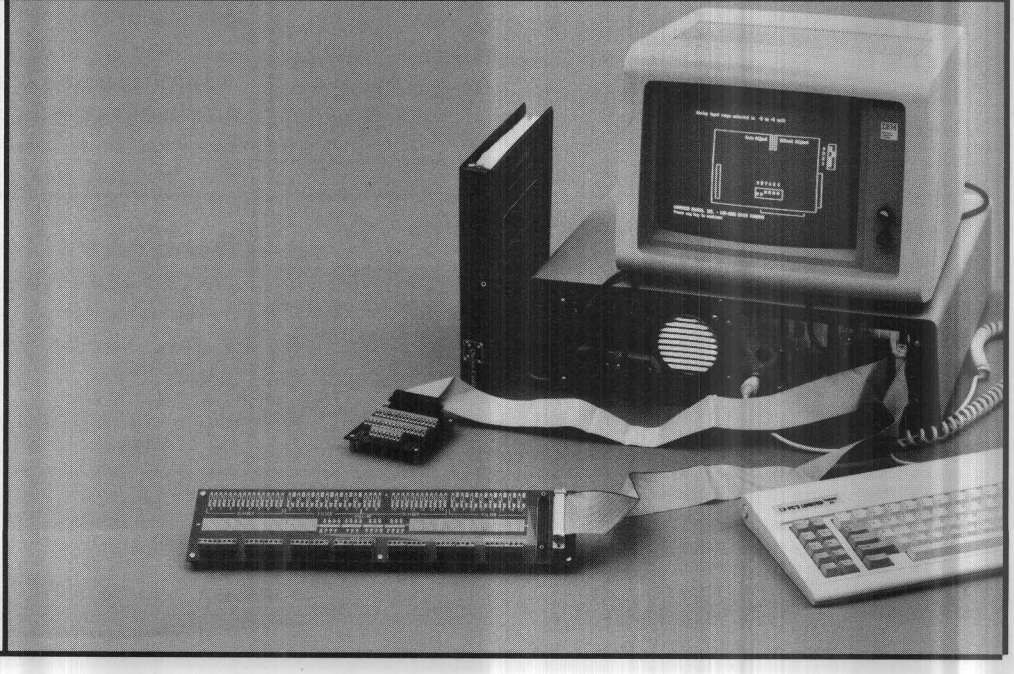
Telephone technical support by qualified data acquisition engineers and high quality manuals with lots of diagrams, illustrations, application notes and an introduction to analog interfacing complete the product.

At Computer Boards, our plan is to bring high quality, industry standard data acquisition products to you at the most agressive prices in the industry. Having many years experience behind us, we know it can be done without compromising quality.

SCREW TERMINALS & CABLES

University & commercial laboratory applications mean frequent signal changes and experiment re-wiring. A screw terminal board mounted on your bench, or up on the wall behind the bench, provides a clean, professional approach to experiment wiring.

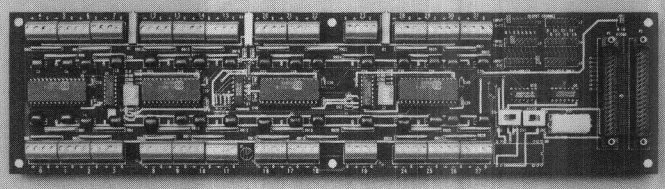
Screw terminals, such as those shown here, accomodate 12-22 AWG wire or spade lugs. Circuitry for common signal conditioning such as voltage dividers and filters is already on the board. You select the correct components and solder them in place. Formulas for component selection and application examples are in the CIO-AD08 manual.



ANALOG EXPANSION MULTIPLEXOR

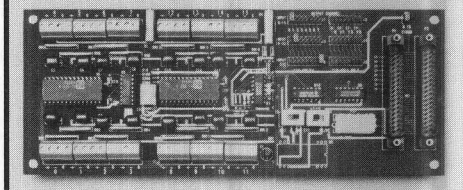
Expand the number of CIO-AD08 analog inputs from 8 up to 128 in increments of 32 or 16. These expansion multiplexor boards provide gains of up to 800, Thermocouple Cold Juction Compensation and 12-22 AWG screw terminals all on one 16" X 4" accessory board. The CIO-MUX series are MetraByte EXP compatible yet very quiet, providing thermocouple stability of 0.25 degree and no channel to channel offset.

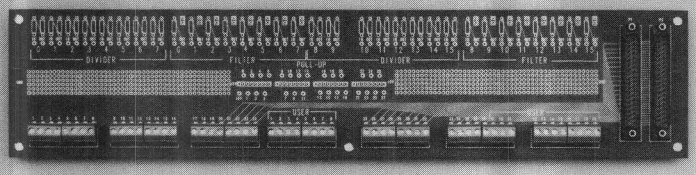
The fully differential analog inputs are amplified by 1, 10, 100, 200, 500 or 800 in banks of 16. Each bank of 16 MUX32 inputs are multiplexed into one AD08 analog input. CJC circuitry requires one AD08 analog input for a total of 112 thermocouples per AD08.



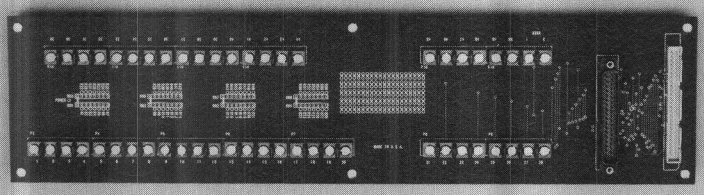
CIO-MUX32 measures 16" X 4".

CIO-MUX16 measures 9" X 4".





CIO-TERMINAL



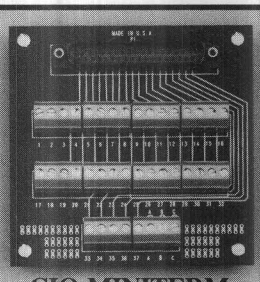
CIO-SPADE50

SCREW TERMINAL ACCESSORIES

Screw terminal boards accept 12-22 AWG wire or spade lugs. The CIO-TERMINAL provides prototype area, pull up resistor, filter and divider circuitry you can populate.

The CIO-SPADE50 has tough spade lugs in a 16" X 4" form factor for easy NEMA cabinet or rack mounting. A good termination panel for industrial applications.

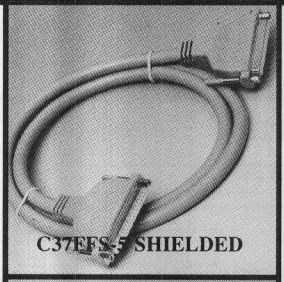
The CIO-MINITERM is the most compact and economical terminal board available. Forty screw terminals provide access to all 37 CIO-AD08 signals plus 4 spares. Two small proto areas are just enough for an op-amp or a few passives.



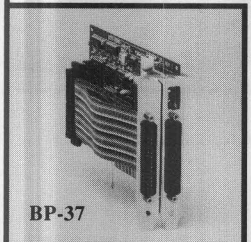
CIO-MINITERM

CABLES & CONNECTORS

Highest quality cables and connectors of all lengths are available from stock. The CIO-AD08 has male 37 D connectors as do the accessory and screw terminal boards. The cables which mate A/D board to screw terminal are terminated with 37 D female connectors at each end. Shielded cables of 5 and 10 feet and ribbon cables of all lengths are available.

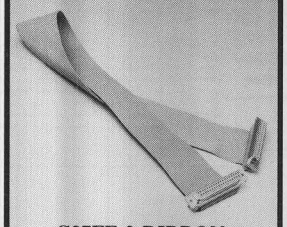


C37FFS-5 SHIELDED



BP-37

The BP37 brings signals from internal connectors to the rear of the PC, where a standard cable joins the BP37 to accessory boards. The BP37 is shown here with a CIO-AD08.



C37FF-2 RIBBON

ORDERING GUIDE

CIO-AD08 multifunction A/D board.	
8 Ch A/D, 31 DIO, 3 CTR50	CIO-AD08
Analog Multiplexor, Thermocouple & CJC	
32 Ch. Diff. Input, 2 Gains, up to 4 per CIO-AD08.	CIO-MUX32
16 Ch. Diff. Input, 1 Gain, up to 8 per CIO-AD08.	CIO-MUX16
Screw Terminal Boards	
16" X 4" all signals from one 37 D plus proto area & circuitry.	CIO-TERMINAL
4" X 4" all signals from one 37 D connector.	CIO-MINITERM
16" X 4" all signals from one 37D, Spade Lug Terminals.	CIO-SPADE50
Cables	
2 foot ribbon cable, 37 conductor, female connectors.	C37FF-2
'N' foot ribbon cable, 37 conductor, female connectors.	C37FF-N
5 foot shielded cable, molded female connectors, 37 cond.	C37FFS-5
10 foot shielded cable, molded female connectors, 37 cond.	C37FFS-10

FREE CALL ROUTINE & PROGRAMS

The CIO-AD08 software package is one of the most extensive free packages in the industry. A BASIC CALL library supports programming of all the AD08's functions. Calibration and test programs keep the AD08 in top form. Lablog II and ACQUIRE are menu driven, easy to use and completely *FREE* with every AD08.

PLEASE TURN TO PAGES 24, 25 & 26 FOR A COMPLETE DESCRIPTION

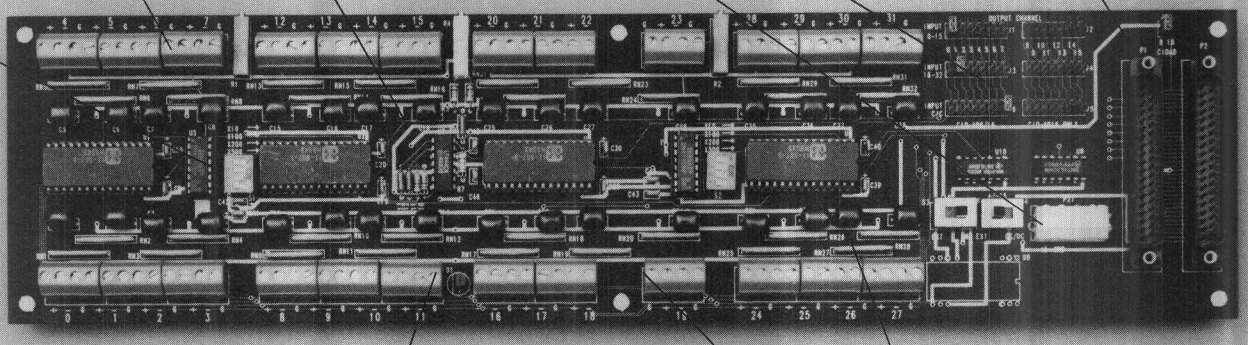
THIRD PARY SOFTWARE SUPPORT

ASYST
Asystant+
Control EG
LabTech Notebook
LabTech Control
Paragon Control
Snapshot Storage Scope
Streamer
TTOOLS
Unkelscope

PLEASE TURN TO PAGES 24 - 30 FOR THESE PRODUCTS

CIO-MUX32

32 Channel Analog Input Multiplexor & Thermocouple Signal Conditioning Accessory Board



DESCRIPTION

The CIO-MUX32 analog input multiplexor expands the total of analog input channels of any A/D board by 32 channels. Two banks of 16 analog inputs, are multiplexed into two of the CIO-AD08, or other A/D board's analog input channels.

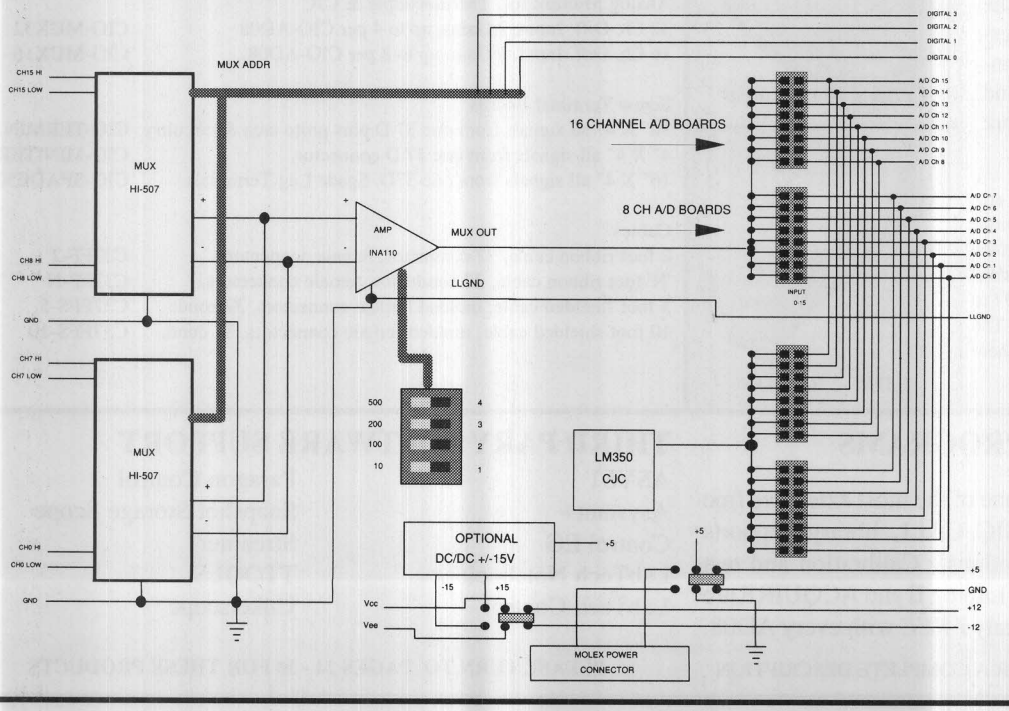
In addition to expanding inputs by a factor of 16, the CIO-MUX32 inputs are fully differential, have two switch selectable gain amplifiers and additional circuitry for Thermocouples.

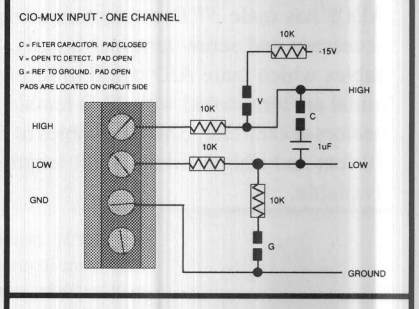
The multiplexors are controlled by 4 digital lines from the CIO-AD08, CIO-AD16 or other A/D board.

Thermocouple measurements are easy with the CIO-MUX32. Each input channel has circuitry for open Thermocouple detect, 7Hz input filtering and 10K ground reference. The passive components which provide these features may optionally be included in each channel's inputs by closing a small solder bridge pad. Thermocouple inputs are relatively quiet at +/- 0.5 deg. C. Additional digital filtering with LABLOG2 (see free software) completely stabilize Thermocouple readings

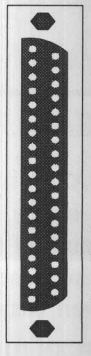
The CIO-MUX32 is fully compatible with MetraByte's EXP-16 and all third party software, such as Labtech Notebook and Control EG.

MUX BOARD BLOCK DIAGRAM - ONE BANK OF 16 INPUTS





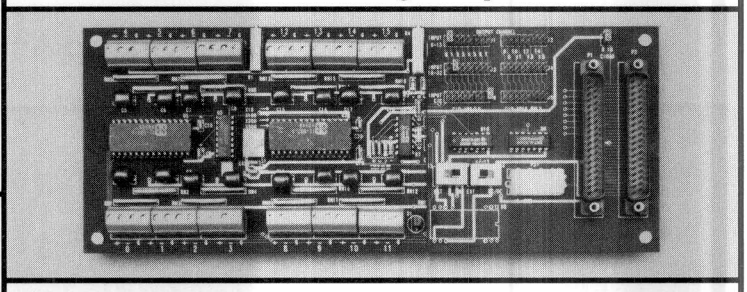
CIO-MUX SIGNAL CONNECTOR



NC/ LLGND	19	37	OUTPUT 0
LLGND/ OUTPUT 8	18	36	OUTPUT 1
OUTPUT 9	17	35	OUTPUT 2
OUTPUT 10	16	34	OUTPUT 3
OUTPUT 11	15	33	OUTPUT 4
OUTPUT 12	14	32	OUTPUT 5
OUTPUT 13	13	31	OUTPUT 6
OUTPUT 14	12	30	OUTPUT 7
OUTPUT 15	11	29	+5 VOLTS
MUX ADDR 4	10	28	POWER GND
MUX ADDR 3	9	27	NC
MUX ADDR 2	8	26	NC
MUX ADDR 1	7	25	NC
NC	6	24	NC
NC	5	23	NC
NC	4	22	NC
NC	3	21	NC
NC	2	20	-12V PC BUS
+12 PC BUS	1		

CIO-MUX16

16 Channel Analog Multiplexor



The CIO-MUX16 is one half of a CIO-MUX32 and shares all the features and specifications of the 32 channel board at a lower cost. For applications where cost is the issue and 16 channels or less of thermocouple or expanded analog input are needed.

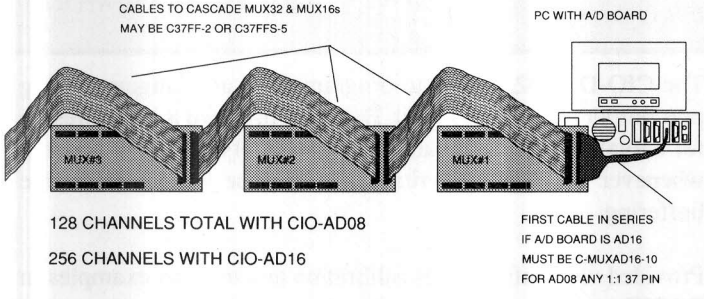
USED WITH THE CIO-AD08

The CIO-MUX32 and CIO-MUX16 are designed to be used as an analog input expansion, amplification and thermocouple input accessory for the CIO-AD08. Each of the 8 CIO-AD08 analog inputs map into 16 of the CIO-MUX inputs. Either 4 MUX32 or 8 MUX16 boards may be connected to a CIO-AD08 expanding the total number of analog inputs to 128. Four of the CIO-AD08 digital outputs control the MUX32 and MUX16 multiplexors

USED WITH THE CIO-AD16

The CIO-MUX32 and CIO-MUX16 may also be used as an analog input expansion amplification and Thermocouple input accessory for the CIO-AD16. Each of the 16 CIO-AD16 analog inputs map into 16 of the CIO-MUX inputs. Either 8 MUX32 or 16 MUX16 boards may be connected to a CIO-AD16 expanding the total number of analog inputs to 256. Four of the CIO-AD16 digital outputs control the MUX32 and MUX16 multiplexors. A cable, C-MUXAD16-10, must be used to connect the CIO-AD16 to the first CIO-MUX, and a DC/DC converter, part no. CIO-PG408 must be installed in each CIO-MUX board.

CASCADING MUX32 & MUX16



CIO-MUX32s and MUX16s may be cascaded to expand the total of analog inputs of any A/D board. Each bank of 16 MUX board analog inputs use one of the A/D board's analog inputs. The MUX32 has two banks of 16 inputs, the MUX16 only one. Cascading MUX boards will raise the number of CIO-AD08 analog inputs from 8 single ended to 128 fully differential!

Each MUX board has one Cold Junction Compensation (CJC) circuit and output. The CJC output uses one of the A/D board's analog inputs and is required when thermocouples are connected to a MUX board. Only one CJC is needed in a series, so a total of 112 thermocouples may be monitored by a CIO-AD08 or 240 with a CIO-AD16.

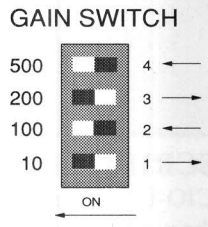
SPECIFICATIONS

CHANNELS	MUX32 = 32, MUX16 = 16
Differential Amplifier	INA110
Gain Weights	1,10,100,200,500
Input Protection	+/- 35 V Continuous
Common Mode Voltage	+/- 10V Max.
Common Mode Rejection	> 90dB All Ranges
Analog Output Voltage	+/- 5V Max.
Thermocouple Types	J,K,T,E,S,R,B
Cold Junction Compensation	+24.4 mV/Deg C (0V @ 0C)
Noise RMS 10KHz - 100KHz	10 uVolts
Accuracy	0.01% of reading +/- 1 bit
Power Consumption MUX32	5V @ 26mA, +/-V @ 36mA
Power Consumption MUX16	5V @ 26mA, +/-V @ 25mA
Dimensions MUX32/ MUX16	16" X 4" / 9" X 4"
Compatibility, SW & HW	MetraByte EXP16 * 2

16 CHANNEL GAIN AMPLIFIER SWITCH

The input gain switch controls the amplification level of the INA110 differential input amplifier. Each switch controls one gain weight and weights are additive. Shown to the right is a gain of 500 + 100 = 600.

When all switches are to the right (off) the amp is at unity gain. In addition, the CIO-AD gains are multiplicative with the CIO-MUX.



RECCOMMENDED THERMOCOUPLE GAIN SETTINGS

TC TYPE	uV / Deg. C	OUTPUT V	@ Deg. C	USE GAIN	Deg.C / Bit
J	51 uV	43 mV	760	100	0.25
K	40 uV	55 mV	1370	100	0.34
T	40 uV	21 mV	400	100	0.34
E	62 uV	76 mV	1000	200	0.5
S	7 uV	19 mV	1760	200	3.0
R	7 uV	21 mV	1760	200	3.0

Data from OMEGA Temperature catalog. Based on 12 bit A/D board 1/4095

ORDERING GUIDE

32 channel analog multiplexor with TC inputs.	CIO-MUX32
16 channel analog multiplexor with TC inputs.	CIO-MUX16
Cable, 37 conductor ribbon, 2 ft.	C37FF-2
Cable, 37 conductor ribbon, ## ft.	C37FF-##
Cable, shielded round cable with molded connectors, 5 ft.	C37FFS-5
Cable, shielded round cable with molded connectors, 10 ft.	C37FFS-10
Cable, sheilded 10 ft. Must be used between the CIO-AD16 and the first CIO-MUX used with a CIO-AD16.	C-MUXAD16-10
DC/DC Converter. 5V in +/-15V out. Must be installed when the CIO-MUX is used with the CIO-AD16	CIO-PG408

SOFTWARE

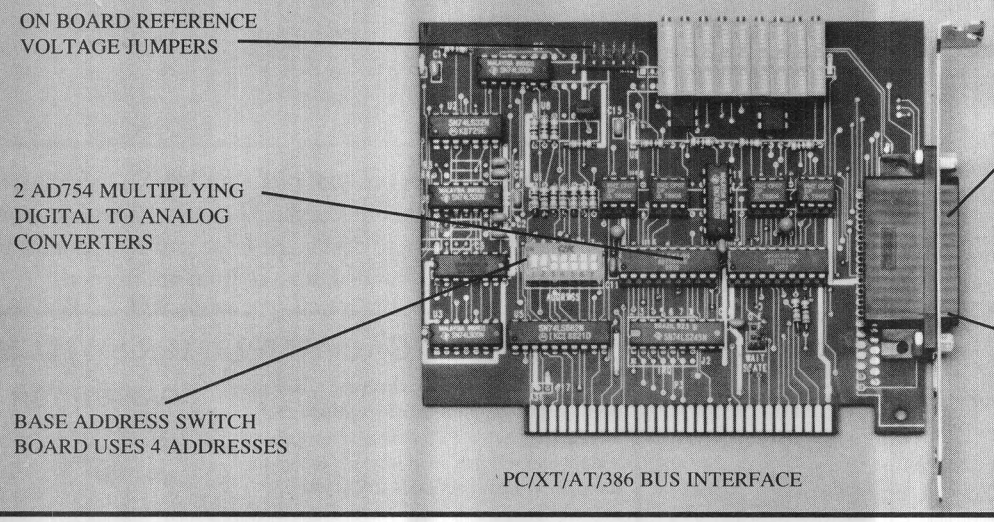
The CIO-AD08 and CIO-MUX combination are supported by:

BASIC CALL	LABLOG2 (free)
Control EG	Paragon Control
LabTech Notebook	PCF08
LabTech Control	TTOOLS

Any software which supports the MetraByte EXP-16 automatically supports the CIO-MUX32 and CIO-MUX16.

CIO-DAC02

2 Channel 12 Bit Digital To Analog Voltage or 4-20 mA Output



DESCRIPTION

The CIO-DAC02 is a versatile analog output plug in board which may be used to control voltage devices with ranges of 0-5, 0-10, +/-5, and +/-10 volts. In addition, 4-20 mA loops may be controlled directly with no additional circuitry.

Each analog output is controlled by a precision 12 bit digital to analog (D/A) converter. A 12 bit converter provides 1/4095 parts resolution. On a scale of 0-5 volts, output can be controlled to within 1.22mV.

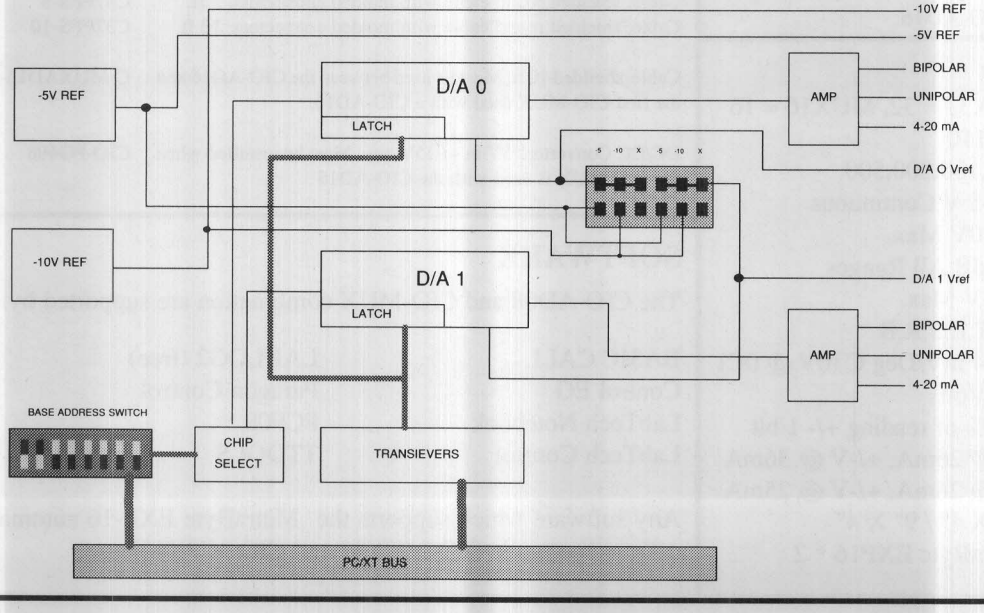
The D/A converter's output range may also be controlled by providing an external DC or AC reference voltage. The D/As are multiplying type and the output range is equal to the reference voltage and of the opposite sign. A -5V Ref = 0-5V output.

The CIO-DAC02 is easy to program from any language using port output commands. Each D/A occupies two 8 bit addresses for a total of 4 for the board. The output of the D/A is updated whenever the MSB is written, a technique known as double buffering.

Provided with software for calibration and test and examples in BASIC.

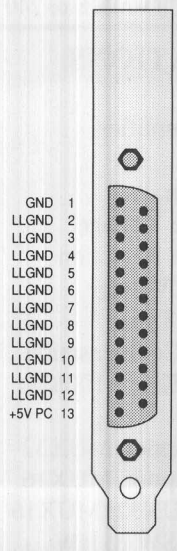
The CIO-DAC02 is 100% compatible with MetraByte's DAC-02 so is supported by a broad range of data acquisition and control software programs. Easier to use than the DAC-02, all output range selection may be done with on board jumpers, avoiding the complex connector wiring required with the MetraByte board.

CIO-DAC02 BLOCK DIAGRAM



CIO-DAC02 CONNECTOR

VIEW FROM REAR OF PC



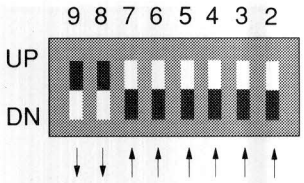
GND	1	14	-10V REF OUT
LLGND	2	15	-5V REF OUT
LLGND	3	16	D/A1 Vref INPUT
LLGND	4	17	D/A1 BIPOLAR
LLGND	5	18	D/A1 UNIPOLAR
LLGND	6	19	D/A1 4-20mA
LLGND	7	20	-10V REF OUT
LLGND	8	21	-5V REF OUT
LLGND	9	22	D/A0 Vref INPUT
LLGND	10	23	D/A0 BIPOLAR
LLGND	11	24	D/A0 UNIPOLAR
LLGND	12	25	D/A0 4-20mA
+5V PC	13		

BASE ADDRESS SWITCH

The CIO-DAC02 is address is set by a an 8 position dip switch located on the board. The dip switch allows the CIO-DAC02 to be located at any address on a 4 bit boundary.

BASE ADDRESS SWITCH

SETTINGS SHOWN - 300 HEX, 768 DECIMAL



SW	DEC	HEX
9	512	200
8	256	100
7	128	80
6	64	40
5	32	20
4	16	10
3	8	8
2	4	4

I/O PORT MAP

The CIO-DAC02 occupies four consecutive I/O ports in the PC's I/O address space, beginning with the board's base address.

Base Address	+0	D/A0	Low Byte
	+1	D/A0	High Byte
	+2	D/A1	Low Byte
	+3	D/A1	High Byte

D/A PORT DATA FORMAT

Each D/A is controlled by data written to two I/O ports. The format of the data is the same for each D/A.

LSB	D7	D6	D5	D4	D3	D2	D1	D0
	B9	B10	B11	B12	X	X	X	X
LSB	D7	D6	D5	D4	D3	D2	D1	D0
	B1	B2	B3	B4	B5	B6	B7	B8

PROGRAMMING THE CIO-DAC02

The CIO-DAC02 is easily programmed from any language which supports output to I/O ports. Each D/A occupies two 8 bit addresses, for example , D/A0 occupies the addresses at the board's base address (LSB), and base + 1 (MSB). To output a voltage with the CIO-DAC02, the desired voltage output must first be split into the LSB and MSB then writen to the ports.

```
10 VOLTAGE = 2.25                          'Desired output voltage is 2.5V
20 ADCOUNTS% = INT(2.25 / 0.00122)         'Convert volts to bits, 0-5V FS
30 MSB% = INT(ADCOUNTS% / 16)              'Find MSB
40 LSB% = (ADCOUNTS% - MSB% * 16)          'Find LSB
50  LSB% = 16 * LSB%                       'Shift LSB 4 places left
60 OUT &H300, LSB%                         'Output LSB, D/A unchanged.
70 OUT &H301, MSB%                         'Output MSB, D/A now = 2.25V
```

This simple BASIC example can be directly translated to any other language, such as C or TURBO PASCAL.

SOFTWARE

The CIO-DAC02 is supported by:

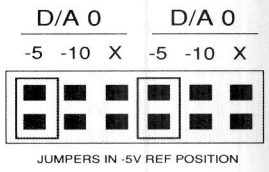
BASIC	Paragon Control
Control EG	TTOOLS
LabTech Notebook	Any Language with
LabTech Control	Port Output

Any software which supports the MetraByte DAC-02 automatically supports the CIO-DAC02.

SETTING OUTPUT RANGES

The output range of the CIO-DAC02 may be set by placing shorting blocks on the jumpers provided on board or by connecting the several reference voltage outputs to the D/A Vref input at the 25 pin D connector.

OUTPUT RANGE SELECT JUMPER BLOCK



JUMPERS IN -5V REF POSITION

The output range jumper block is shown here. One of the ranges provide may be selected or the jumper may be placed in the X position if an external reference will be provided.

Once the reference voltage is chosen, the output of the D/As is available on three of the 25 pin connector's output pins. The three outputs are Unipolar, Bipolar and Current.

V Ref	Unipolar	Bipolar	Current
-5	0 to 5V	+/-5V	4-20mA
-10	0 to 10V	+/-10V	
Ext.	2 Quadrant	4 Quadrant	

Once the output range is chosen the voltage or current output is controlled by writing a value between 0 and 4095 to the D/A converter. The relationship of the D/A digital data to the voltage output is different for unipolar and bipolar ranges.

A 0 D/A value corresponds to 0 volts unipolar and +full scale (+FS) bipolar. A 4095 D/A value corresponds to +FS unipolar and -FS bipolar. The following table applies for Vref = -5V

D/A Value	Unipolar	Bipolar
0	0.0V	+5.0V
2048	2.5V	0.0V
4095	5.0V	-5.0V

ORDERING GUIDE

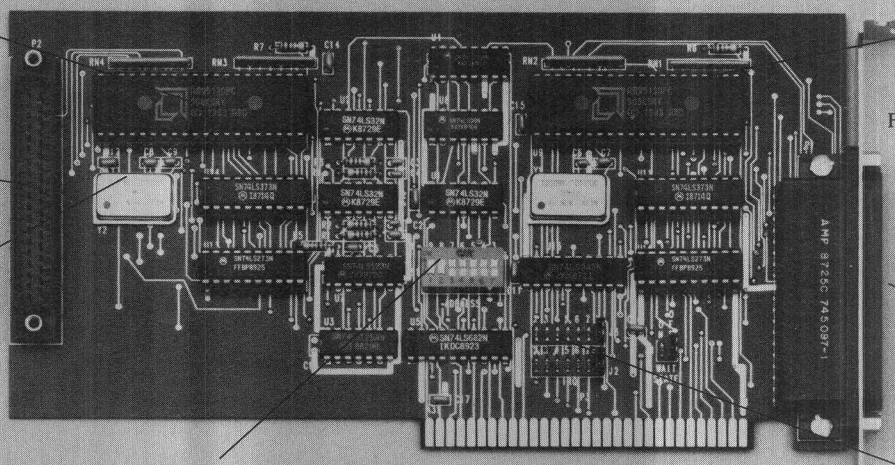
2 channel, 12 bit analog output plug in board	CIO-DAC02
Connector kit for constructing a cable	DFCON-25

SPECIFICATIONS

CHANNELS	2
Resolution	12 bits, 1 part in 4095
Relative accuracy	1/2 LSB 0.01% Max.
Differential Linearity	1/2 LSB Max.
On-board reference ranges	0 to 5V, 0 to 10V +/-5V, +/-10V 4-20mA current loop
External reference voltage	+/-10 Max
Voltage output impedance	< 0.1 ohm Max.
V output drive current	+/-5 mA Min.
4-20 mA compliance	8-36 V
Settling time, full scale step	150 uS to 0.001% typ.
Power Consumption MUX16	5V @ 100 mA Max.
Dimensions MUX32/ MUX16	+/-12V @ 25/35mA Max.
Compatibility, SW & HW	MetraByte DAC-02

CIO-CTR10 & CIO-CTR05

10 Channel 16 Bit Counter/Timer with 16 Digital Outputs & 16 Digital Inputs



DESCRIPTION

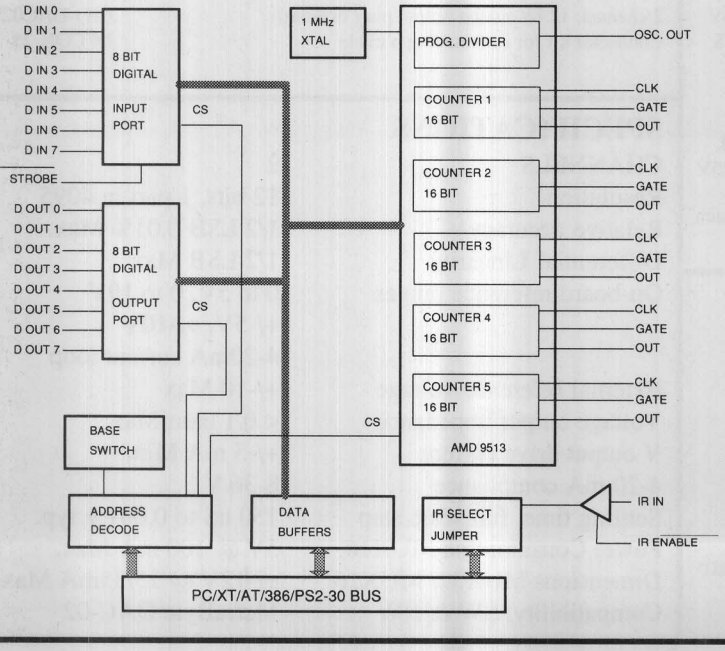
The CIO-CTR10 is two high performance counter/timer chips and supporting circuitry on a 3/4 size PC/XT/AT/PS30 bus expansion board.

Employing two 9513 counter/timer chips, each providing five counters with 16 bit (65,536 count) count registers. The 9513 is an extremely powerful and flexible component which is software programmable for event counting, pulse & frequency measurement, alarm comparator and other input functions. As an output device the 9513 can generate frequencies with complex duty cycles and provide one shot and continuous outputs.

The 9513 counters may be chained via software enabling a 32, 48, 64 or 80 bit counter to be constructed withing the chip. In addition the gate source and gating functions are software programmable. A BASIC CALL routine provided with the CIO-CTR10 supports most 9513 modes of operation, and is 100% compatible with MetraByte's CTM-05 software.

An 8 bit latched digital output port may be used to switch solid state relays and an 8 bit strobed digital input port may be used to sense contact closures. Access to the PC bus interrupts is provided via two interrupt jumpers. A 1MHz crystal on board supplies a precise source of timing pulses.

BLOCK DIAGRAM (1/2 OF CTR10 SHOWN HERE)



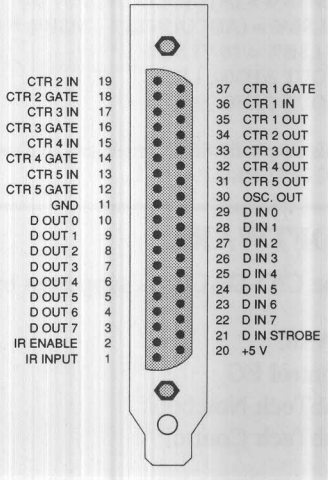
CABLING & CONNECTION

Cabling to the CIO-CTR10 is via two standard 37 pin D type connectors.

Each cable caries all counter inputs, outputs and gates for one 9513, 16 digital lines, +5 volts and ground.

Each is 100% CTM-05 compatible.

CIO-CTR10 CONNECTOR
VIEW FROM REAR OF PC



I/O REGISTER MAP

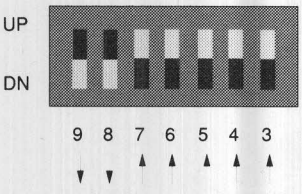
The I/O registers of the CIO-CTR10 occupy 8 I/O locations in the PC's I/O address space. The first, or BASE, address is fixed by the base address switch. The CIO-CTR05 uses only the first four addresses

BASE + 0	9513 #1 DATA	BASE + 4	9513 #2 DATA
BASE + 1	9513 #1 CONTROL	BASE + 5	9513 #2 CONTROL
BASE + 2	DIGITAL INPUT	BASE + 6	DIGITAL INPUT
BASE + 3	DIGITAL OUTPUT	BASE + 7	DIGITAL OUTPUT

Set BASE address by switching inputs to a comparator. Each switch corresponds to one address line on the PC bus. Each switch represents one address weight and weights are added to determine a unique address.

BASE ADDRESS SWITCH

SETTINGS SHOWN - 300 HEX, 768 DECIMAL



SW	DEC	HEX
9	512	200
8	256	100
7	128	80
6	64	40
5	32	20
4	16	10
3	8	8

ACCESSORIES

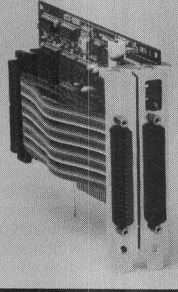
Counters work best when the inputs have sharp, clean edges. Often, the signal source is a button or a switch that bounces or glitches, or the signal may be 0-24V or some voltage higher than TTL levels.

The CIO-TERMINAL combines screw terminals with signal conditioning circuitry. Voltage divider and low pass filter circuits occupy a portion of the 16" X 4" board area. To de-bounce a counter input, simply populate one of the low pass filter circuits and connect it to the counter's input signal.

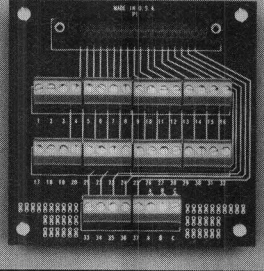
Some people prefer spade lugs over screw terminals. The CIO-SPADE50 is designed for rugged NEMA cabinet mounting and accepts spade lugs on it's terminals.

For economy of space and funds, the CIO-MINITERM provides 12-22 AWG screw termination of all 37 signals plus four spares, for one half the cost of larger screw terminal boards.

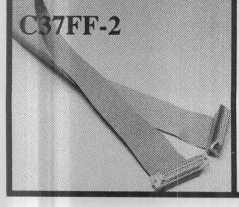
BP37



CIO-MINITERM

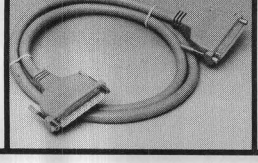


C37FF-2



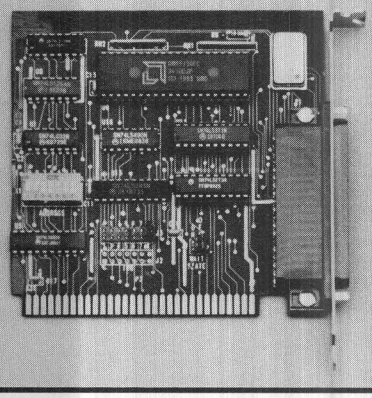
High quality cables can save you hours of valuable time.

C37FFS-5



CIO-CTR05

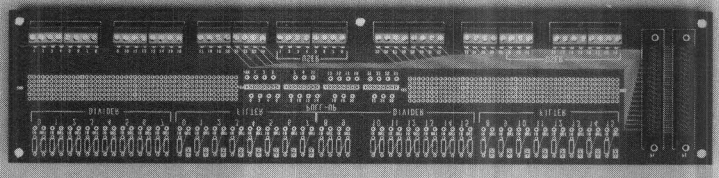
5 Channel Counter/Timer with 8/8 Digital In/Out



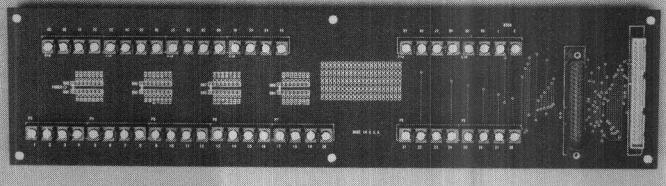
DESCRIPTION

The CIO-CTR05 is exactly one half of a CIO-CTR10 so the block diagram, connector pin-out and programming information apply to both boards. The CIO-CTR05 has one 9513 counter/timer chip, 8 digital inputs and 8 digital outputs. The CTR05 is an economical solution for those applications where 5 or fewer counters are needed and cost is an issue.

CIO-TERMINAL



CIO-SPADE50

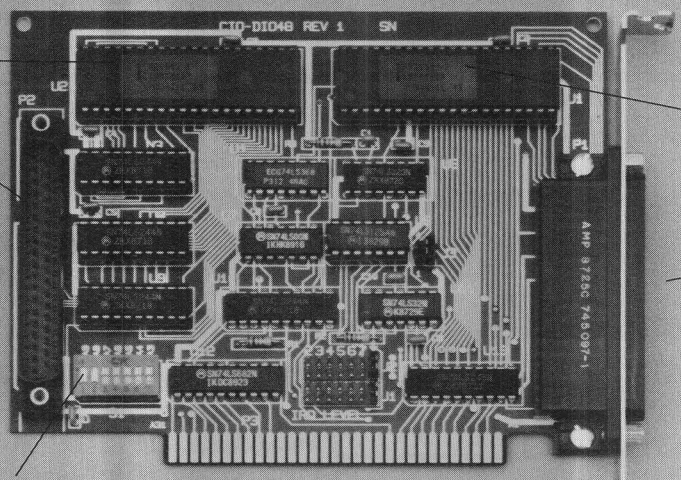


ORDERING INFORMATION

10 Counters (16 bits), 16 Digital In, 16 Digital Out	CIO-CTR10
5 Counters (16 bit), 8 Digital In, 8 Digital Out	CIO-CTR05
16" X 4" Screw Terminal w/ Debounce & V Divide	CIO-TERMINAL
4"X 4" Economy Screw Terminal	CIO-MINITERM
16" X 4" Spade Lug termination pannel	CIO-SPADE50
Cable, 37 Conductor, Female both ends, 2 ft.	C37FF-2
Cable, 37 Conductor, Female, Custom length.	C37FF-#
Cable, 37 Conductor, Female, Sheilded Round with molded connector ends, 5 ft. and 10 ft. lengths.	C37FFS-5 C37FFS-10
Backplate, cable & connector to rear 37 pin connector	BP-37
Connector Kit, AMP crimp pins, connector & shell.	DFCON-37

CIO-DIO48

48 Digital I/O as 24 TTL Input/Output & 24 High Drive Output Only



THIS 8255 WILL PROVIDE:
HIGH DRIVE PIO-24 OUTPUTS.

8255 DIGITAL I/O
100% PIO-12 & PIO-24
SOFTWARE COMPATIBLE

BASIC CALL SOFTWARE &
COMPLETE MANUAL
PROVIDED WITH EVERY CIO-DIO48

THIS 8255 IS 100% PIO-12
COMPATIBLE

37 PIN 'D' TYPE
CONNECTOR IS 100%
PIO-12 COMPATIBLE

SMALL BOARD FITS IN
PC/XT SHORT SLOT

BASE ADDRESS SWITCH

PC/XT/AT/386/PS30 CONNECTOR

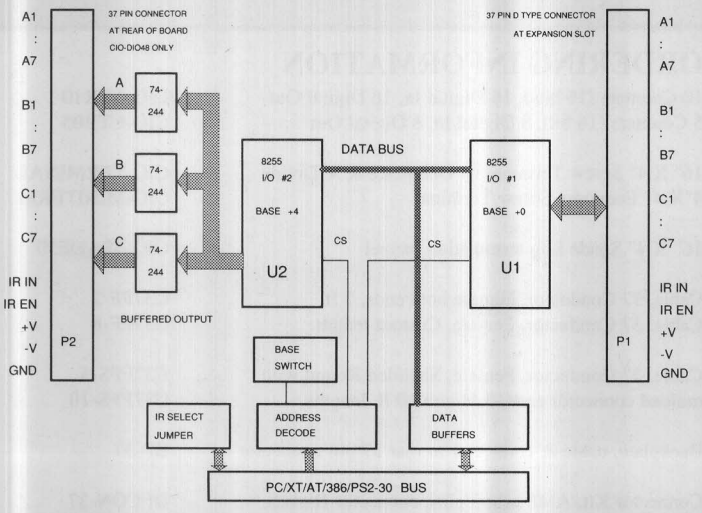
DESCRIPTION

The CIO-DIO48 is a low cost, high density digital I/O board designed for use in any PC/XT/AT/386/PS2-30 or compatible computer.

Employing two 8255 digital I/O chips, each controlling 24 digital lines, the board may be used for byte wide or bit I/O of TTL level signals. High output drive circuitry on the second 8255 provides PIO-24 compatible outputs.

The CIO-DIO48 is software and connector compatible with MetraByte PIO-12 and PIO-24 boards.

BLOCK DIAGRAM



CABLING & CONNECTION

Cabling to the CIO-DIO48 is via two standard 37 pin D type connectors. Each cable caries 24 digital I/O lines, +5 volts and ground.

Cables are available in a variety of lengths. A screw terminal board, the CIO-MINITERM, provides 40 standard 12 - 22 AWG screw terminals. The CIO-SPADE50 provides terminals for 50 spade type connections.

Each connector carries 24 digital I/O lines.

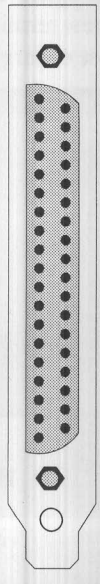
The second 8255 has optional high drive 74244 output buffers, providing PIO-24 compatible outputs.

Each 8255 has 24 I/O lines. The chip is configured as 3 ports. Two ports, A & B, are 8 bits wide. Port C may be an 8 bit port or two 4 bit ports.

Individual ports may be configured as Input or Output and are written to and read from as a unit. Computer Boards supplies software for bit I/O.

Connector extending from the expansion slot bracket is shown. Pin-outs are identical for both connectors

CIO-DIO48 CONNECTOR
VIEW FROM REAR OF PC



GND	19	37	PORT A 0
+5 V	18	36	PORT A 1
GND	17	35	PORT A 2
-12 V	16	34	PORT A 3
GND	15	33	PORT A 4
-12 V	14	32	PORT A 5
GND	13	31	PORT A 6
-5 V	12	30	PORT A 7
GND	11	29	PORT C 0
PORT B 0	10	28	PORT C 1
PORT B 1	9	27	PORT C 2
PORT B 2	8	26	PORT C 3
PORT B 3	7	25	PORT C 4
PORT B 4	6	24	PORT C 5
PORT B 5	5	23	PORT C 6
PORT B 6	4	22	PORT C 7
PORT B 7	3	21	GND
IR ENABLE	2	20	+5V
IR INPUT	1		

I/O REGISTER MAP

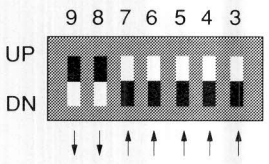
The I/O registers of the CIO-DIO48 occupy 8 I/O locations in the PC's I/O address space. The first, or BASE, address is fixed by the base address switch.

BASE + 0	PORT A, 8255 #1	BASE + 4	PORT A, 8255 #2
BASE + 1	PORT B, 8255 #1	BASE + 5	PORT B, 8255 #2
BASE + 2	PORT C, 8255 #1	BASE + 6	PORT C, 8255 #2
BASE + 3	#1 CONTROL	BASE + 7	#2 CONTROL

Set BASE address by switching inputs to a comparator. Each switch corresponds to one address line on the PC bus. Each switch represents one address weight and weights are added to determine a unique address.

BASE ADDRESS SWITCH

SETTINGS SHOWN - 300 HEX, 768 DECIMAL



SW	DEC	HEX
9	512	200
8	256	100
7	128	80
6	64	40
5	32	20
4	16	10
3	8	8

PROGRAMMING

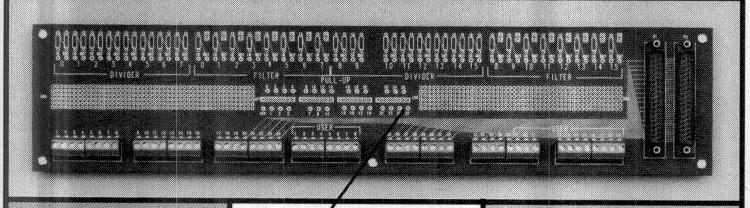
The CIO-DIO48 and CIO-DIO24 are very easy to program from any language which supports writing to and reading from I/O ports. Referring to the port map above, the 8255 has only 4 registers. Three of these are the 8 bit data ports and one is a control register. A single write to the control register programs all three 8 bit data ports for input or output. The ports may then be written to or read from directly.

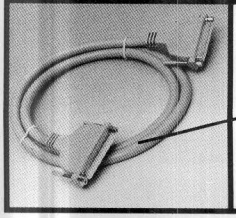
For those using GWBASIC or the QUICK BASIC compiler, there is a BASIC CALL routine which automates programming of the control register and provides direct bit oriented control and monitoring. Bit I/O is far more appropriate to most digital applications than byte wide I/O.

For monitoring, logging, printing, alarming and displaying the status of up to 32 digital inputs, FREE LABLOG2 software is easy to use with pull-down menus and on-line context sensitive help screens. LABLOG2 is yours free, with your order of a digital I/O board.

ACCESSORIES

Screw terminals, spade lug termination panels and cables can save you hours of wasted effort and 'professionalize' the visible portion of your PC based digital application.

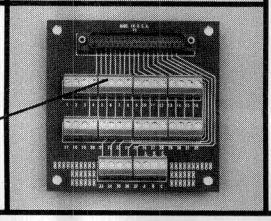




CIO-TERMINAL

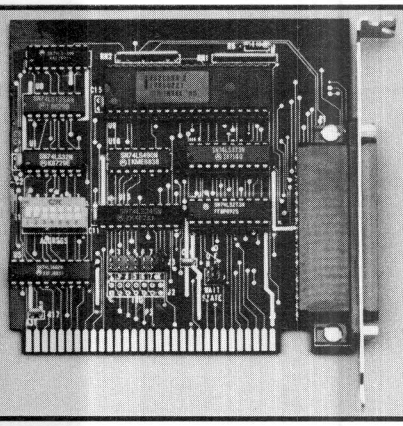
C37FFS-5

CIO-MINITERM



CIO-DIO24 & CIO-DIO24H

24 TTL Digital Input/Output



DESCRIPTION

The CIO-DIO24 is a 24 bit digital I/O board providing two 8 bit and two 4 bit digital ports (8255). The 8255 is wired directly to a 37 pin connector which also has signals for PC power and ground. The CIO-DIO24H emulates 8255 mode 0 (simple input and output) while providing high drive inputs and outputs. The connector pin-out is shown on the opposing page and is identical to that of the CIO-DIO48 and MetraByte PIO-12 and PIO-24.

The CIO-DIO24 is 100% MetraByte PIO-12 software and hardware compatible at less than 1/2 the price. The CIO-DIO24H is 100% MetraByte PIO-24 compatible at 1/3 the price!

SPECIFICATIONS

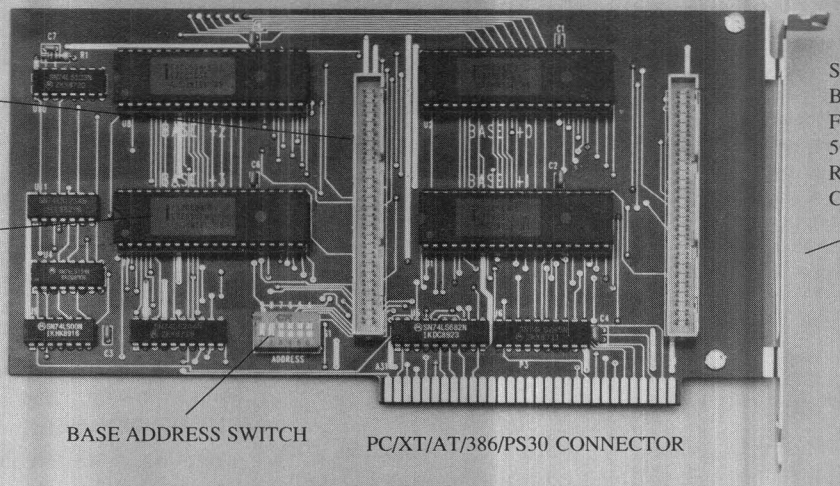
	CIO-DIO48	CIO-DIO24
# TTL Digital I/O	24 as 3, 8 bit ports	24 as 3, 8 bit ports
# Digital High Drive Output Only	24 as 3, 8 bit ports	None
TTL I/O		
Logic low level	-0.5 to 0.8V Max	-0.5 to 0.8V Max.
Logic high level	2.0 to 5.0V Max	2.0 to 5.0V Max
Input current	+/- 10 uA	+/- 10 uA
Output sow sink current	1.7 mA @ 0.45V	1.7 mA @ 0.45V
Output high source current	-200 uA @ 2.4V	-200 uA @ 2.4V
HIGH DRIVE OUTPUTS		
Output low voltage	0.55V	**CIO-DIO24H**
Output low sink current	64 mA	
Output high voltage	2.0V	High drive on the
Output high source current	15 mA	DIO24H only
Interrupt inputs	2	1
Power Consumption +5V	400 mA	250 mA
Compatibility	PIO-24, PIO-12	PIO-12 or PIO-24

ORDERING GUIDE

48 Digital I/O, 24 TTL I/O, 24 High Drive Output Only	CIO-DIO48
24 TTL Digital I/O	CIO-DIO24
24 High drive input and output.	CIO-DIO24H
16" X 4" Screw Terminal, 12-22 AWG terminals.	CIO-TERMINAL
4" X 4" Screw Terminal, 12-22 AWG terminals.	CIO-MINITERM
16" X 4" Spade Lug Termination Pannel	CIO-SPADE50
Cable, 37 Conductor ribbon, Female-Female, 2 ft.	C37FF-2
Cable, 37 Conductor ribbon, Female, custom length	C37FF-#
Cable, 37 Conductor shielded round, Female, 5 foot	C37FFS-5
Cable, 37 Conductor shielded round, Female, 10 foot	C37FFS-10
Backplate, Cable & Connector for rear 37 pin connector	BP-37
Connector Kit, AMP crimp pins, connector & shell	DFCON-37

CIO-DIO96

96 Bit Digital TTL Level Input/Output



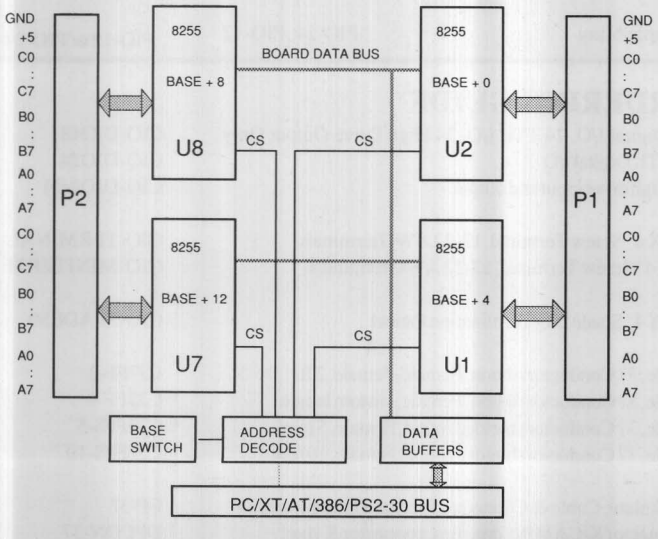
DESCRIPTION

The CIO-DIO96 is a low cost, high density digital I/O board designed for use in any PC/XT/AT/386/PS2-30 or compatible computer.

Employing four 8255 digital I/O chips, each controlling 24 digital lines, the board may be used for byte wide or bit I/O of TTL level signals.

The CIO-DIO96 is software compatible with MetraByte PIO-12 and PIO-96 boards and uses fewer cables due to more concentrated signal density on the cable.

BLOCK DIAGRAM

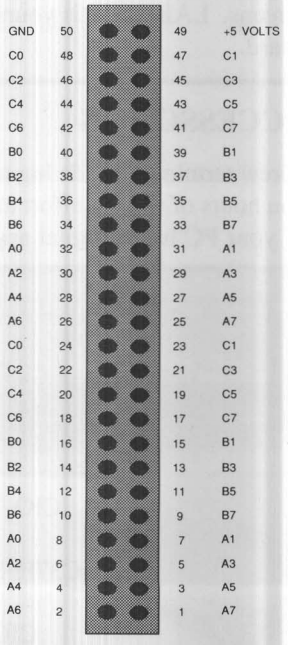


CABLING & CONNECTION

Cabling to the CIO-DIO96 is via two standard 50 pin, 0.10 inch spacing AMP type ribbon cable connectors. Each cable caries 48 digital I/O lines, +5 volts and ground.

Cables are available in a variety of lengths. A screw terminal board, the CIO-TERM100, provides 100 standard 12 - 22 AWG screw terminals. The CIO-SPADE50 provides terminals for 50 spade type connections.

VIEW FROM COMPONENT SIDE OF BOARD



Each connector carries 48 digital I/O lines. One 8255 on pins 1-24 and one on pins 25-48. The chip labeled U2 is at BASE address + 0. Chip U1 is at BASE + 4.

Each 8255 has 24 I/O lines. The chip is configured as 3 ports. Two ports, A & B, are 8 bits wide. Port C may be an 8 bit port or two 4 bit ports.

Individual ports may be configured as Input or Output and are written to and read from as a unit. Computer Boards supplies software for bit I/O.

Connector closest to the expansion slot bracket is shown. On the second connector:
Chip U8 = BASE+8
Chip U7 = BASE+12

LABLOG II , FREE WITH EVERY CIO-DIO96

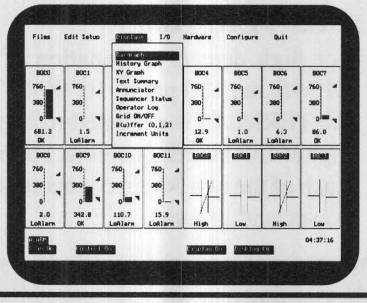
Real Time Displays: up to 6 different types may be viewed while data is being collected. On line help screens are context sensitive.

Features Include

Up to 32 Digital inputs.
Change displays "on the fly".
Change Alarms "on the fly".
16 Channel Bargraph display.
64 Channel annunciator display.
16 Channel text display
High and Low Alarms
8 Levels of Group Displays
Data Loging to Disk & Printer
On line, context sensitive HELP

Plug in your CIO-DIO96 and begin collecting data immediately; at no additional expense. LABLOG II from Quinn-Curtis Software is a full function data acqusition package with pop-up menus and full CGA, Hercules or EGA graphics.

A bargraph display of up to 32 digital values in a process control faceplate format is just one of the displays in Lablog II. Alarm status and the real time value are updated constantly.



I/O REGISTER MAP

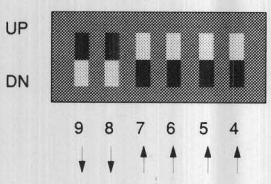
The I/O registers of the CIO-DIO96 occupy 16 I/O locations in the PC's I/O address space. The first, or BASE, address is fixed by the base address switch.

BASE + 0	PORT A #1	BASE + 8	PORT A #3
BASE + 1	PORT B #1	BASE + 9	PORT B #3
BASE + 2	PORT C #1	BASE + 10	PORT C #3
BASE + 3	#1 CONTROL	BASE + 11	#3 CONTROL
BASE + 4	PORT A #2	BASE + 12	PORT A #4
BASE + 5	PORT B #2	BASE + 13	PORT B #4
BASE + 6	PORT C #2	BASE + 14	PORT C #4
BASE + 7	#2 CONTROL	BASE + 15	#4 CONTROL

Set BASE address by switching inputs to a comparator. Each switch corresponds to one address line on the PC bus. Each switch represents one address weight and weights are added to determine a unique address.

BASE ADDRESS SWITCH

SETTINGS SHOWN - 300 HEX, 768 DECIMAL



SW	DEC	HEX
9	512	200
8	256	100
7	128	80
6	64	40
5	32	20
4	16	10

ORDERING GUIDE

96 Bit digital I/O board	CIO-DIO96
Screw Terminal Boards	
16" X 4", 100, 12-22 AWG Screw Terminals	CIO-TERM100
16" X 4", 50 Spade Lug Terminals	CIO-SPADE50
Cables	
2 foot, 50 conductor cable	C50FF-2
Custom length, 50 conductor cable	C50FF-##

WE ARE PROUD TO OFFER THE VERY BEST SOFTWARE & APPLICATION MANUALS WITH EVERY CIO-DIO DIGITAL BOARD

BASIC CALL ROUTINE & EXAMPLES

Most applications are unique, and therefore may best be implemented with software designed by you. A BASIC call routine and example programs included with every CIO-DIO96 greatly simplify programming.

The BASIC CALL is easy to use. The form of the CALL is:

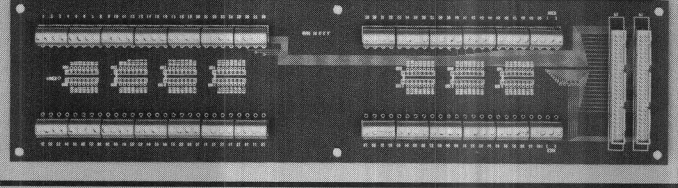
10 CALL CIO96(MODE%, DATA%(0), FLAG%)

The mode number tells the CALL software which function to perform. Information such as 8255 control, bit number and byte port as well as the I/O data are passed in the DATA%() array. A flag indicates the success or failure of the function.

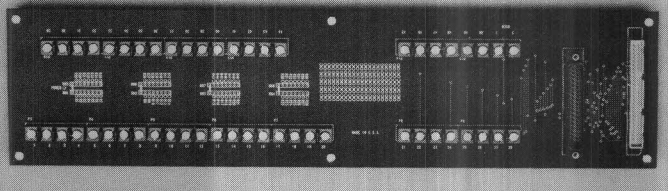
```
10 MODE% = 55                                  ;Mode 55, 8255 control
20 DATA%(0) = 0                                ;Set port A as output
30 DATA%(1) = 0                                ;Set port B as output
40 DATA%(2) = 1                                ;Set PortC Low as input
50 DATA%(3) = 0                                ;Set port C high as output
60 DATA%(4) = 3                                ;Chip # to program
60 CALL CIO96 (MODE%, DATA%(0), FLAG%)         Execute the CALL
70 IF FLAG% <> 0 THEN PRINT "ERROR"            ;Check for errors

100 MODE% = 56                                 ; Mode 56, bit set
110 DATA%(0) = 72                              ; Bit # to set, 1-96
120 DATA%(1) = 1                               ; Set bit high
130 CALL CIO96 (MODE%, DATA%(0), FLAG%)        ; Execute the CALL
140 IF FLAG% <> 0 THEN PRINT "ERROR"           ; Check for errors
```

The first CALL configures the input/output status of the 8255 mode control register for the third 8255 in sequence (chip #3 on a DIO96). The second CALL sets one bit of an output port high. All the work of reading the port's current status and combining the desired bit with the other bits of the port is done by the CALL. Several other modes for bit read and byte I/O are included. No other company supplies so much software with every digital board!

CIO-TERM100



CIO-SPADE50



SCREW TERMINAL BOARDS

Ease signal connection & professionalize your work area

CIO-TERMINAL

This universal screw terminal accessory provides easy signal connection to miniature screw terminals which accept 12-22 American Wire Gauge (AWG) wires.

Any I/O board with a 37 pin signal connector may employ the CIO-TERMINAL for signal termination. It's large size (16" X 4") make it ideal for bench or rack mounting. A generous prototype area is complimented by circuitry for voltage dividers, low pass filters and pull up resistors. These extra circuits are frequently used to condition signals, and may be populated by you with exactly the right components for the application. The circuitry and component selection is fully explained in the plug-in board users manual.

Two 37 pin D type connectors provide 1:1 feed through to other accessory boards.

CIO-SPADE50

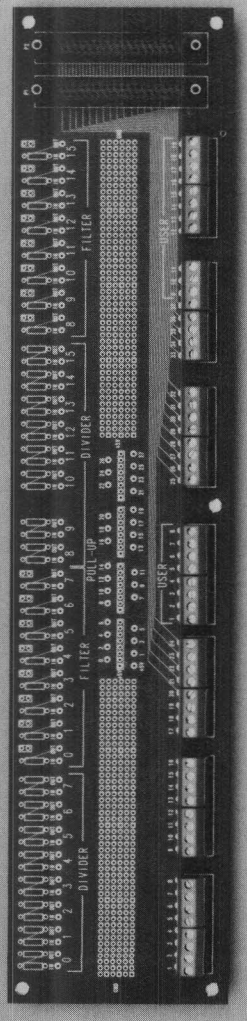
Due to their larger size and ruggedness, spade lugs are preferred over screw terminals by some industrial customers. The SPADE50 is a versatile 16" X 4" termination panel which mates with both 37 pin and 50 pin connectors.

Spade lugs are available from Radio Shack and industrial hardware suppliers. A spade lug is crimped onto each signal wire. The spade lug and signal wire are then mounted on the SPADE50.

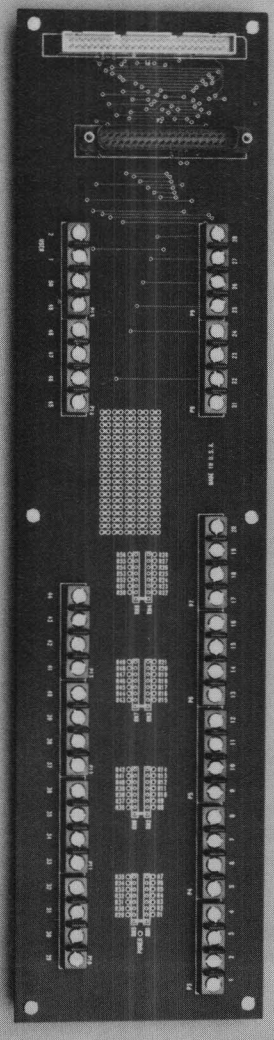
CIO-TERM100

For high density termination of the digital signals from a CIO-DIO96, the 100 point, 16" X 4" TERM100 does the job. Because the TERM100 is designed to be used only with the CIO-DIO96, a digital I/O board, positions for pull up resistors are on the board. Each of the two 50 pin connectors carry 48 digital I/O lines, +5V PC power and ground.

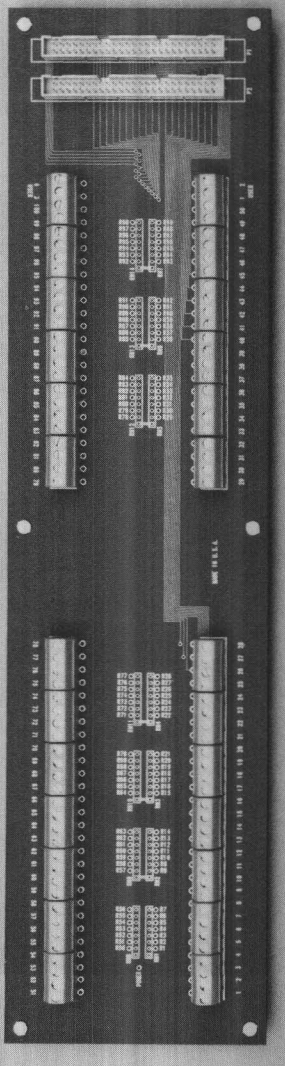
CIO-TERMINAL



CIO-SPADE50



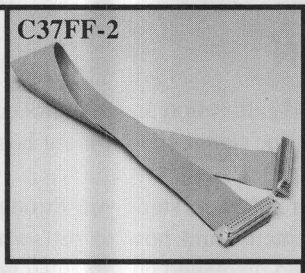
CIO-TERM100



CABLES & ACCESSORIES

Ease signal connection & professionalize your work area

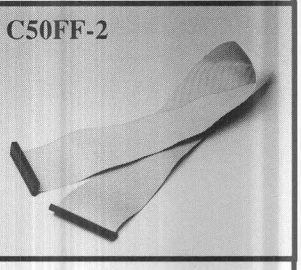
C37FF-2



The 2 foot, 37 conductor ribbon cable is the most popular method of cabling from an I/O board to a screw terminal or other accessory board. The cable has female D type connectors at each end.

Available in any length by ordering part # C37FF-#, where # is the length in feet.

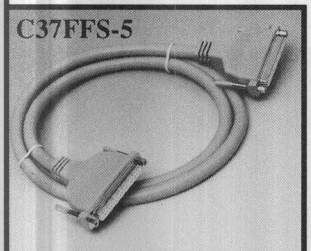
C50FF-2



For use with the DIO-96, the C50FF-2 has female 50 pin ID connectors on each end of a 2 foot ribbon cable.

This cable may be ordered in any length by part # C50FF-#, where # is the length in feet. Please see the price list to calculate the cost.

C37FFS-5



Shielded cables offer superior noise immunity and round cable with molded connectors are the most durable.

This 37 conductor cable with female D type connectors at each end is available in 5 and 10 foot lengths only.

DFCON-37

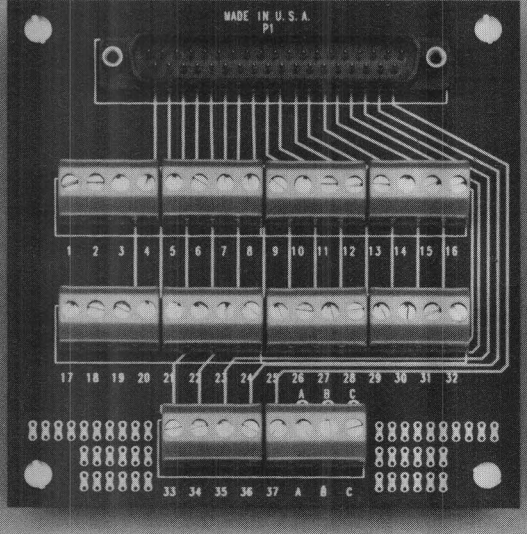
Frequently it is convenient to connect signal wires directly to the I/O board without using a screw termination pannel. In those cases, the **D** type **F**emale **CON**nector kit for 37 pin connectors (DFCON-37) or for 25 pin connectors (DFCON-25) make it easy to construct a custom cable.

CIO-MINITERM

The economical MINITERM is just the screw terminal accessory for tight places; or tight budgets. Measuring only 4" by 4", the MINITERM mates with the C37FF series of cables and thereby to any I/O board with a 37 pin connector.

It is truly a universal screw terminal accessory because all the signals from the 37 pin connector are brought directly to a numbered 12-22 AWG screw terminal. The number on the screw terminal corresponds to the number on the 37 pin connector.

Four additional screw terminals and a small proto area add some flexibility for signal conditioning.



A NOTE ON CABLES

The cables we offer are universally equipped with female connectors at each end. The female connectors on the cable are intended to mate with the male connectors found on I/O boards and screw terminal and signal conditioning accessories.

The male connector is always mounted on the board because, of the two, the female connector is more likely to wear out. The tiny sockets in a female connector spread with frequent insertions and removals, eventually resulting in too loose a fit for a good signal. It is more economical to replace a cable than a board.

OTHER ACCESSORIES

CMOLEX-10

A 10 foot, 2 conductor cable used to bring +5V power and ground from the PC to active accessory boards such as the SSH-16, MUX32 and MUX16. This item is included with every SSH-16. It is optional with the MUX32/16 and not required when a MUX and AD08 or AD16 are used in combination. It is helpful if several MUX boards are to be used with a CIO-AD##.

C-MUXAD16-10

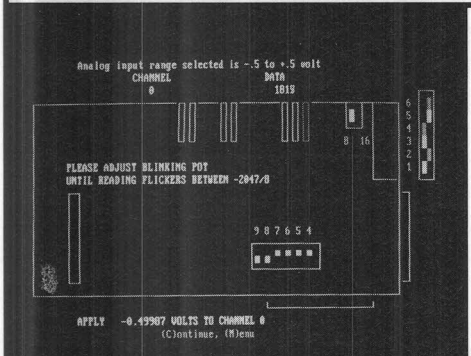
A 10 foot, 37 conductor shielded cable with a special cross wireing for use only with the CIO-AD16 and CIO-MUX combination. This Cable is used between the CIO-AD16 and the first MUX board and resolves the differences between the AD16 pin out and that of the MUX. Additional cascaded MUX boards use the C37FF-2

CIO-PG408

The PG408 is a +5V to +/-15V DC/DC converter which may optionally be installed on the CIO-MUX boards. It is required equipment when the MUX is used with the CIO-AD16.

FREE SOFTWARE

Calibration, Test, BASIC CALL, Programming Examples, Lablog2 & Acquire



CALIBRATION

A complete, automated calibration and test procedure is included with every *Compatible I/O Series*™ analog I/O or signal conditioning board.

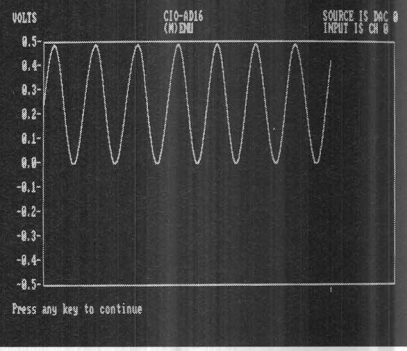
Automated calibration software steps you through each phase of calibration, indicating where to make adjustments and how to set switches. Current readings are constantly updated by software and displayed on screen so you can see when calibration is complete.

This calibration program also exercises all active portions of the board allowing you to quickly verify installations and locate trouble.

TEST & EXAMPLE PROGRAMS

Several test programs, like the IOTEST program shown here, are included with every *CIO Series* analog or digital board. The test programs show you what is really happening on signal inputs, or give positive control of outputs. Compiled into stand alone EXEcutable files, these programs provide a base to test signal hook-ups with confidence.

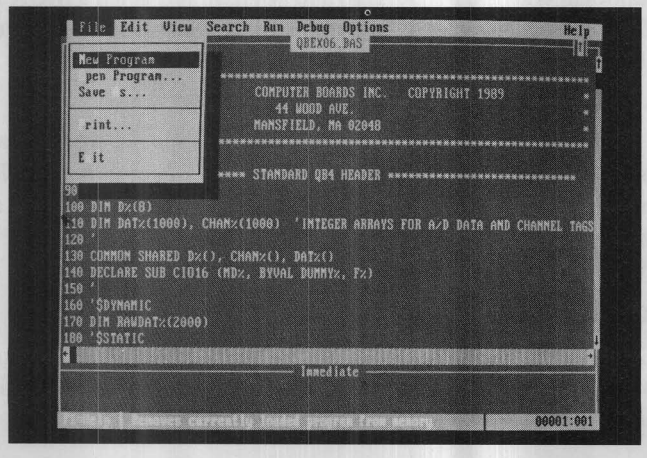
A number of the test programs are written in BASIC and the source code is supplied on the disk. These and other example programs provide a basis for building applications using the supplied BASIC CALL software.



BASIC CALL

A high performance data acquisition and control board has sophisticated features which allow it to acquire data and transfer measurements to memory using the full potential of the personal computer. Employing these features to best advantage requires the use of interrupt service routines, DMA transfers and register I/O in ASSEMBLY language.

A BASIC CALL is a program, written in ASSEMBLY language, which can be called from within a GWBASIC or Quick Basic program. Commands and data are passed to the CALL routine which then executes the commands, causing outputs from the I/O board or acquiring data from it's inputs.



The form of the CALL is simple and easy to use. A variable called the Mode is given a value. That value indicates that a certain type of function is to be performed. If data or other instructions are required by the CALL, they are assigned to the data passing array. The CALL is executed and the measurements made are passed back to BASIC in a BASIC array. Here is an example.

```
100 MD% = 50                          'Mode 50, complete A/D to BASIC
110 D%(0) = 0                         'Lower scan limit is Channel 0
120 D%(1) = 3                         'Upper scan limit is Channel 3
130 D%(2) = 50                        'Acquisition speed in KHz
140 D%(3) = 0                         'Addititional speed in hundreds of Hz
150 D%(4) = 24000                     'Number of samples to take
160 D%(5) = VARPTR(ADDATA&(0)         'Array for measurements
170 D%(6) = VARPTR(CHDATA%(0)         'Array for channel tags
180 D%(7) = 1                         'Wait for high on digital input 0
190 D%(8) = 0                         'Execute the acquisition run only once
200 CALL CIO16(MD%, D%(0), F%)        'Now execute the CALL
```

Mode 50 is a good example of a complex procedure which is simplified by using a BASIC CALL. Here is the entire sequence of events through the completion of the CALL.

The personal computer's DMA controller is initialized as are the A/D board's channel scan registers and sample pacer clock. The software then loops continuously until a high (+5V) signal is present on digital input 0. When DI0 goes high, the A/D samples and channel tags are transfered to the PC's memory where they are stored until all 24,000 samples are taken. After the acquisition run is complete, the data and channel tags are separated and each is transfered from memory into a BASIC array. Once in an array, the data is available for manipulation and analysis.

In addition to complex data acquisition routines, simple but helpful modes are supplied. For example, digital I/O boards are constructed of chips with ports which are 8 bits wide. Rarely does an application call for digital input or output to be done 8 bits at a time but every time one bit is read or written, an entire 8 bit port must be accessed. How about a Mode that reads or sets only *one bit at a time*? That would save some effort!

```
100 MD% = 56                              'Mode 56, bit set.
110 D%(0) = 17                            'Set bit number 17
120 D%(1) = 1                             'Set the chosen bit high (+5V)
130 CALL CIODIO(MD%, D%(0), F%)           'Execute the CALL
```

Here is one that reads only one bit.

```
100 MD% = 57                              'Mode 57, bit read
110 D%(0) = 7                             'Bit number to read
120 CALL CIODIO(MD%, D%(0), F%)           'Execute the CALL
```

It is true that many choices of programming language exist, and each has its champions, but today, BASIC compilers and the greater number of individuals trained in BASIC make it a good place to start and a fine language for writing entire applications in.

The BASIC CALL is a useful tool and it is free with **every** board!

LABLOG2

Lablog2 is a complete menu driven data acquisition software package. This is the complete acquisition portion of Control EG, limited to 24 analog inputs and 32 digital inputs.

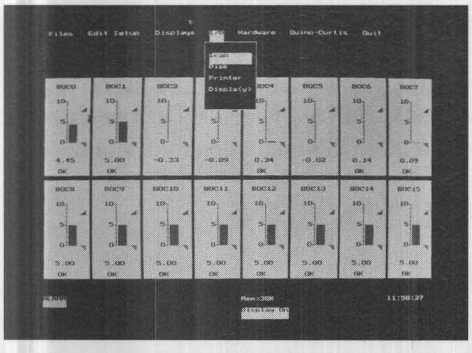
Lablog is a low speed (10 Hz) acquisition, display, data log and print log program. It will acquire from CIO-AD16 and AD08 analog input boards and employ CIO-MUX boards for thermocouple input. Thermocouples inputs are linearized and may be displayed in history graphs, bar graphs and text displays (see the three displays below).

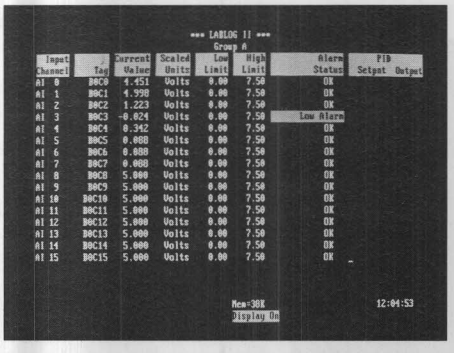
Six different types of real time displays may be viewed while data is being collected.

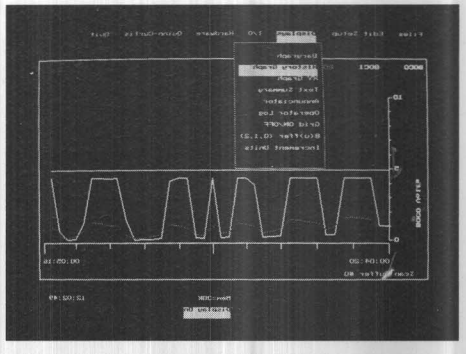
Lablog features include:

Up to 24 A/D and 32 digital inputs.	16 Channel Bargraph display.
Measure voltage, temperature, presure.	16 Channel Stripchart display.
User defined calculated inputs.	16 Channel X Y plot display.
J,K,T,E,R,S & B thermocouples.	16 Channel text display.
High and low alarms.	64 Channel annunciator display.
Alarm filter.	8 levels of group displays
Change alarms on the fly.	Change displays on the fly.
Data logging to disk, printer.	On line context sensitive HELP
Lotus 1-2-3 file or ASCII.	Real time scheduler.

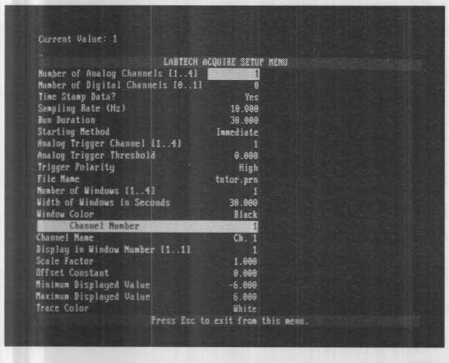
As a thermocouple measurement, alarming and logging program used with the CIO-AD08 and CIO-MUX, Lablog2 is an outstanding, full-function application. It is also great for other low speed jobs!







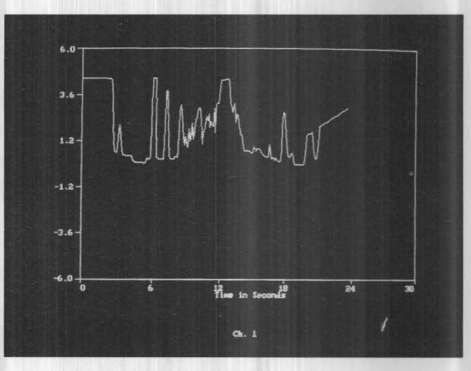
Labtech ACQUIRE



Acquire is a complete, menu driven, data acquisition program which very closely resembles Labtech Notebook. Acquire is limited to 4 channels of input at a maximum of 50Hz per channel.

Set-up is fully fill-in-the-blanks menus, as shown to the left, and acquired data may be stored in a file and displayed on screen in real time, as shown to the right.

A complete users manual is supplied on disk in ASCII and postscript files.



A WORD ABOUT LABLOG2 & ACQUIRE, FREE SOFTWARE

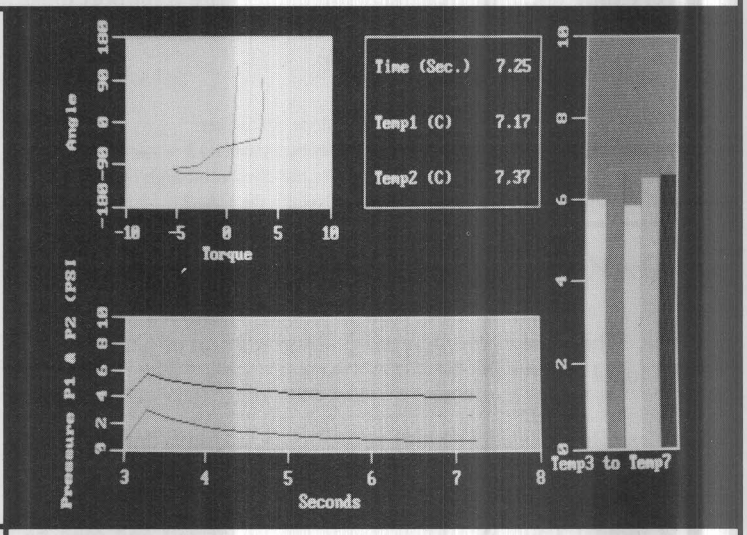
Lablog2 from Quinn-Curtis Software and Acquire from Laboratory Technologies are provided free to you because we at Computer Boards, Inc. want you to have some easy to use, menu driven software to use the minute you open the box and install an I/O board. The software companies want you to see what their style of software is all about, and to buy a full-featured package such as Control EG from Quinn-Curtis or Labtech Notebook from Laboratory technologies. Both free software packages come on disk, with a manual or help file which you must print out. Please, when you use them and encounter their limitations, remember they are free and are intended to be working examples of what a complete package would provide. In our opinion they are excellent quality and useful too. That is why we bear the expense of providing them to you, and supporting them. Thanks.

LABTECH NOTEBOOK

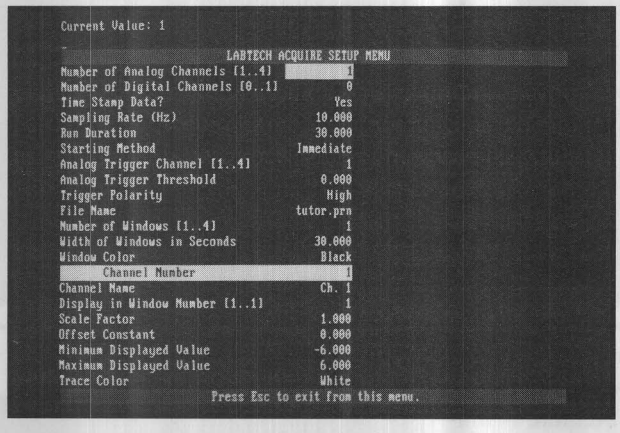
Full Featured, High Speed, Data Acquisition, Control, Display and Logging. Menu Driven

Complete, automated data acquisition and control.
Features include:

- Menu driven. No programming skill required.
- Complete tutorial and documentation ease self learning.
- Real-time, high speed data acquisition (100KHz with CIO-AD16/F).
- Real time processing and display of data (low speed display only).
- Operates in the foreground or background.
- Thermocouple linearization.
- Continuous data storage to disk.
- Lotus 123™ data files written to disk allow
  - Data reduction and analysis.
  - High quality chart output
- FFT of sampled data.
- Curve fitting routine with up to 10 parameters, can use 8087 for speed.
- Real-time process control, open or closed loop.



Labtech Notebook is a fill-in-the-blanks menu driven data acquisition and control program that takes full advantage of A/D board features like interrupt processing, DMA sample transfer and complex triggering. Notebook is a time-tested program that has been available since the early eighties and consistantly tops reader surveys of popular data acquisition software.



The Labtech Acquire menu above is typical of the menus included in Notebook. Options such as channel type, range and sample speed are called out to the left and empty blanks must be filled out to the right. Often, default values are automatically placed in the fill-in section where they may be accepted or changed.

SPECIFICATIONS

Sampling Rate, A/D	20KHz (CIO-AD08) 50KHz (CIO-AD16) 100KHz (CIO-AD16/F)
Output Rate, D/A	30Hz
Trigger Methods	Keyboard, Time Delay, External
Run Duration	10^{16} Seconds max.
Control Modes	PID and ON/OFF
Number of Loops	10^{8}

DISPLAYS

Notebook supports windowing of displays allowing you to place history graphs, bar graphs and process variables on one screen. The layout and placement of windows is menu controlled making it very easy to customize the look and feel of your application.

Of course, all the configuration information can be saved to a file and instantly loaded and started. Using Notebook it is easy to build stand alone systems that require minimal operator training.

DISPLAY SPECIFICATIONS

Number of windows	15 max.
Traces per window	50
Continuous storage to disk	400Hz

REAL TIME ACCESS

Real Time Access is an extension to Notebook that allows data acquired by Notebook (in the background) to be 'piped' directly into other programs such as Lotus 123, NWA Statpack, dBASE, MathCAD and others. Normally Notebook writes data to files that can be read and post processed by these applications. With Real Time Access, the data is processed in real time. Order LTN-RTA.

NOTEBOOK SUPPORTS

CIO-AD08	CIO-AD16
CIO-DAC02	CIO-AD16/F
CIO-CTR05	CIO-CTR10
CIO-DIO24	CIO-MUX32
CIO-DIO48	CIO-MUX16
CIO-DIO96	CIO-SSH16

CONTROL EG

Low Speed Data Acquisition and Control with Data Logging and Display.

CONTROL EG

Control EG from Quinn-Curtis Software is a full function data acquisition and control package with pop-up menus and full CGA, Hercules or EGA graphics.

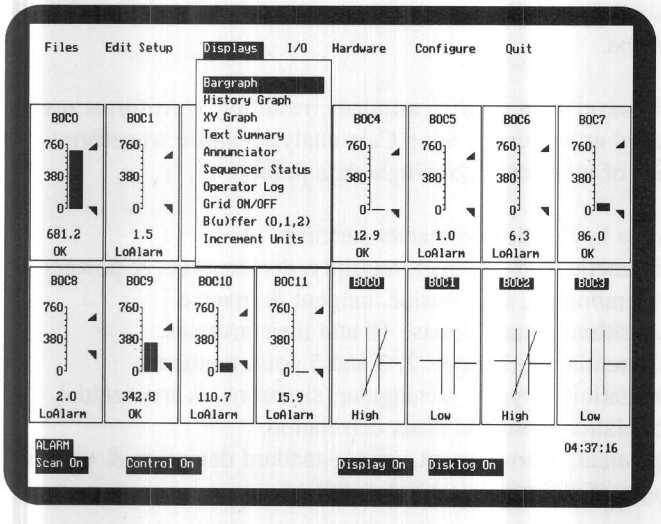
When used with the CIO-MUX thermocouple measurement accessory, Control EG is a powerful temperature measurement, logging and alarming system. Add digital output and heaters, blowers, ovens and burn-in chambers may be precisley controlled.

Features Include

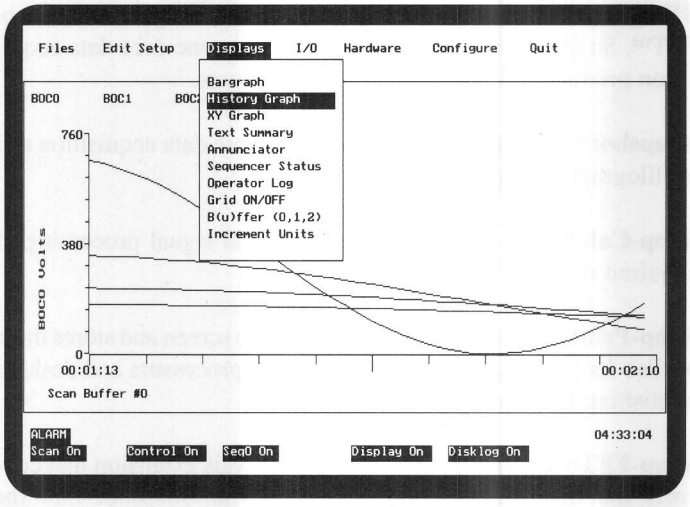
Up to 128 Analog input and 32 out.
Up to 128 Digital inputs and 128 outputs.
A total of 256 active points at one time.
Measure Voltage, Temperature, Preasure.
Linearize J,K,S,T,E,R, & S thermocouples
User defined calculated inputs.
Change displays "on the fly".
Change Alarms "on the fly".
16 Channel Bargraph display.
64 Channel annunciator display.
16 Channel stripchart/history display.
16 Channel XY plot display.
16 Channel text display.
8 Levels of group displays

High and Low Alarms
Alarm Filter
Data Loging to Disk & Printer
Real Time Scheduler
Up to 64 PID loops.
Up to 64 calculated channels
Sequencer and digital logic functions

Lotus 123 import file support.
On line, context sensitive HELP



A bargraph display of analog or digital values in a process control faceplate format is just one of the displays in Control EG. Alarm status and the real time value are updated constantly.



Real Time Displays: up to 6 different types may be viewed while data is being collected. On line help screens are context sensitive.

Control EG is easy to learn and easy to use. Its self documenting feature and ability to store configurations in setup files add reliability also. A context sensitive help file with complete information on a pull down menu's options is available at the F1 key at any time during configuration.

What makes Control EG easiest to learn is that you receive a copy of Lablog2 with every CIO board. Lablog2 is the fully functional acquisition portion of Control EG limited to 24 channels. Once familiar with Lablog2's features, learning the additional Control EG output functions is a snap.

ORDERING GUIDE

Control EG supports these CIO Series boards.

CIO-AD16 analog input.
CIO-AD08 analog input.
CIO-MUX32 & MUX16 with either the AD16 or AD08.
CIO-DAC02 analog output.
CIO-DIO24, 48 & 96

Required hardware:
IBM PC/XT/AT or compatible
CGA, EGA, VGA or Hercules display

SNAPSHOT STORAGE SCOPE

Data Acquisition, Oscillographic Display & Analysis

THE SNAP SERIES

SNAPSHOT™ Storage Scope, Snap-Calc™, Snap-Print™, Snap-FFT™, Snap-Filter™ and Snap-Stream™ are one core data acquisition product and five enhancement products.

Snapshot™ Storage Scope provides the core data acquisition and oscillographic display.

Snap-Calc™ provides general analysis and signal processing of acquired data.

Snap-Print™ captures waveforms from the screen and stores them in files for printing or merging with word processors and desktop publishing programs.

Snap-FFT™ is a frequency spectrum analysis extension that converts the time domain data acquired with Snapshot into the frequency domain.

Snap-Filter™ adds powerful digital filtering to remove unwanted frequencies from acquired waveforms.

Snap-Stream™ acquires and stores data directly to hard disk at rates up to 100KHz.

SNAPSHOT STORAGE SCOPE

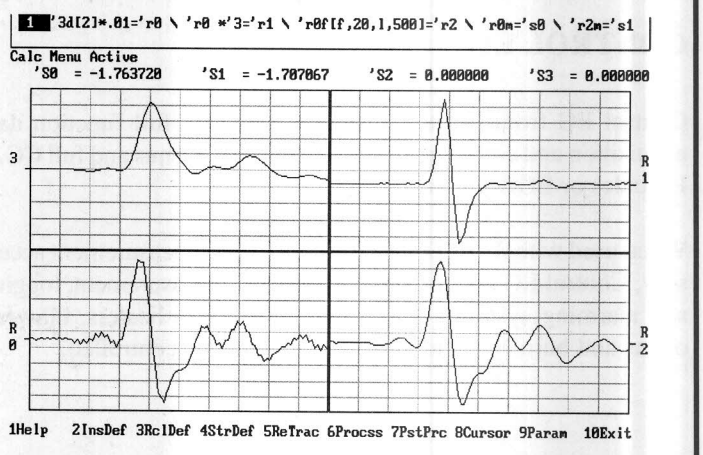
Snapshot Storage Scope is the core program in the Snap series software, and is designed for acquisition, display, and storage of analog data. Its menus are easy to use, setting up analog or digital triggers and acquisition to the full speed of the A/D board.

Snapshot supports acquisition from the CIO-AD16, CIO-AD16/F and CIO-AD08.

Snapshot offers the versatlity of an oscilloscope by displaying as many as 16 acquired channels and 16 processed waveforms with labels and engineering units for each channel, while providing features of a data acquisition system. The software averages trigger-synchronized waveforms, generates X-Y plots, allows for a title for each frame of data, and reads and writes data files.

No programming is required. Use menus to specify parameters for data acquisition, triggering, analog and digital outputs. Use viewing parameters to define labels, offset and zoom factors, and conversion factors for each channel. Convenient submenus provide detailed information on selected parameters and virtually eliminates the need to consult the users manual.

SNAPSHOT SUPPORTS
CIO-AD16 CIO-AD16/F CIO-SSH16 CIO-AD08



Screen display of plotted waveforms provides immediate feedback regarding data quality. The display identifies sensitivity of each channel in engineering units, number of points collected, user specified title, data and time of the test, channel labels and menu options.

SNAP-CALC

Snap-Calc is tightly integrated with Snapshot and provides general analysis and signal processing of acquired data during both testing or post-processing.

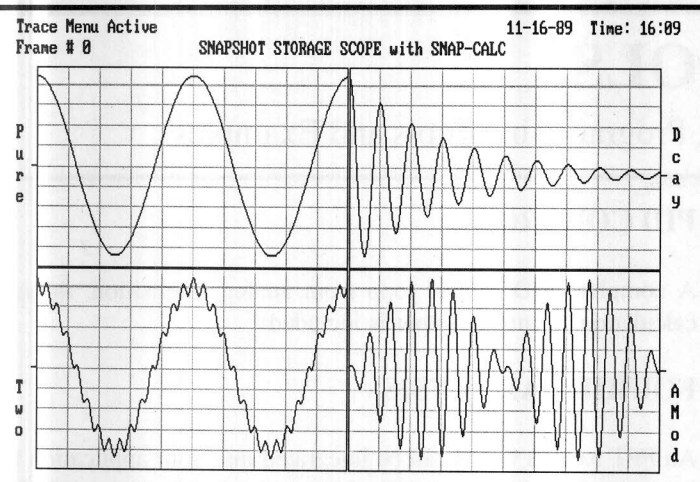
Snap-Calc capitalizes on Snapshot's graphics, cursors, engineering units, stored acquisition parameters, analog and digital input/output and its acquisition, storage and retrieval capabilities. This seamless interface between acqusition and analysis tremendously simplifies the burden on the user to define the desired analysis. Complexities such as array sizes and stack locations are handled for you.

Whenever new data is acquired, resulting waveforms are displayed at one time. Snap-Calc analyzes entire waveforms, portions of waveforms, or single data points.

Single keystroke commands perform:
Arithmetic, add, subtract, multiply, divide, roots & powers.
Trigonometric, sine, cosine, tangent & inverse.
Logarithmic, natural, base 10 and their inverses.
Differentiation, 3 types: 2, 3 and 5 point methods.
Integration, 3 types: rectangular, simpsons, & trapezoidal.
Correlation, auto and cross correlation.
Statistical, avarage, max., min., standard deviation & variance.
Logic, If, Then, Else, AND & OR.

16 SIMULTANEOUS CHANNELS

Used with Computer Boards' CIO-SSH16, Snap-Series software supports acquisition and analysis of 16 simultaneous channels with no channel to channel skew!



In the interactive calculation menu of Snap-Calc, the top line displays five equations separated by backslashes. The upper waveform is the original acquired waveform, lower left is the derivative of the waveform; upper left is the product of the waveform; and lower right is the R0 filtered using a FIR low pass filter.

SNAP-PRINT

Snap-Print is a utility program that provides a flexible method for producing high quality hard copies or screen dumps of graphic screens. Capture waveforms displayed on the screen onto disk for susequent hardcopy output or merging of graphical information into other programs such as word processors or or desktop publishers. Snap-Print can also take any graphic screen and print it directly to a number of printers.

You can also specify left and top margins on the page, horizontal and vertical image size, draft or quality print, number of copies and whether black and white are to be reversed during printing.

In fact, the waveform/screen images on these two pages were captured and output with Snap-Print.

SNAP-FFT

Snap-FFT is a frequency spectrum analysis software package which converts time domain data acquired with Snapshot into the frequency domain. Snap-FFT calculate amplitude and phase for 1 or up to 16 channels of data in one run. As many as 2048 data points are processed. Window types include Hanning, extended cosine bell or cosine 4th power.

Advanced functions include: 10 window types, power spectrum, correlation, convolution, impedence, transfer function and coherence. Complex math includes: addition, subtraction, multiplication, division, logarithm (dB) and complex conjugate. Includes smoothing as well as averaging in both the time domain and frequency domain.

SNAP-FILTER

Snap-Filter adds digital filtering to the data acquisition and analysis capabilities of Snapshot and Snap-Calc to remove unwanted frequencies from acquired waveforms. Design all four types of filters: low-pass. high-pass, band-pass, and band-reject. Use either a Finite Impulse Response (FIR) to preserve the time relationship of the signals components, or an Infinite Impulse Response (IIR) filter to emulate common analog filters and their sharper attenuation. Or use low-pass Hanning moving average filters to smooth data.

Snap-Filter uses only 15 keystrokes to define a filter and plot both input and output data to provide immediate feedback on the filters effectiveness.

SNAP-STREAM

Snap-Stream will sample up to 500 million data points directly to hard disk in one continuous stream at up to 100KHz on a 386 based PC (65KHz on a 286), or directly to RAM disk at up to 100KHz.

Snap-Stream has four unique features: (1) automatic measurement of maximum disk throughput, (2) pre-testing user defined streaming parameters, (3) determining available disk space, and (4) optimizing the disk. Without auto-sensing and pre-testing you would have to perform time consuming trial-and-error streams to define the disk's maximum throughput.

SPECIFICATIONS

Number of channels samples	up to 16
Number of waveforms displayed	up to 32
Maximum scan rate	100KHz (AD16/F)
Minimum scan rate	1 scan/minute
Maximum samples per scan	32,768
	500 million (Stream)
Trigger types	Software, A/D or DI

ORDERING GUIDE

SNAPSHOT STORAGE SCOPE	SNP-SHOT
SNAP-STREAM may be run stand-alone	SNP-STREAM
SNAP-SERIES 100 Snap-Shot + Snap-Calc + Snap-Print	SNP-100
SNAP-SERIES 200 SNP-100 + Snap-FFT + Snap-Filter	SNP-200

Note: Snap-Stream has two prices. One if purchased alone and another if purchased with Snapshot or a Snap-Series.

DELIVERY: 7 Days on all SNP products.

T-TOOLS

TURBO PASCAL Software Drivers, Programming Tools and Examples

DESCRIPTION

TTOOLS is a complete set of drivers which provide access to interrupts, DMA transfers and all the other features of the:

CIO-AD16/F	CIO-AD08
CIO-DAC02	CIO-DIO24/48/96
CIO-MUX32/16	CIO-CTR05/10

In addition to supporting standard input, output and triggering, TTOOLS also includes examples and software routines for:

THERMOCOUPLE LINEARIZATION

Thermocouple measurements must be linearized and corrected for cold juction error. TTOOLS includes routines to accomplish that for thermocouple types S,R,E,J,K & T.

REAL TIME LINE PLOTS & BAR GRAPHS

Creating and controlling graphic representations of acquired data can be the most time consuming portion of a programming task. Helpful routines for line plots and bar graphs are easy to include in your own code.

PID CONTROL

A complete PID control loop from analog acquisition, through calculation to analog output is included.

FOURIER ANALYSIS

An FFT routine which can be integrated into your application for power spectrum analysis, vibration monitoring or other analytical purposes

TURBO-LABLOG

TTOOLS also includes a complete, menu driven data acquisition and control package. Data may be acquired and displayed in real time on line and bar graphs or logged to disk for later analysis with Lotus 123.

The programming examples contained in this application will save you hours of 'invention' and Turbo-Lablog may be a good basis on which to build your own custom designed application program.

C-TOOLS

TURBO 'C' & MICROSOFT 'C' Software Drivers, Programming Tools and Examples

DESCRIPTION

C-TOOLS is a complete set of drivers which provide access to interrupts, DMA transfers and all the other features of the:

CIO-AD16/F	CIO-AD08
CIO-DAC02	CIO-DIO24/48/96
CIO-MUX32/16	CIO-CTR05/10

Written entirely in C, the C-TOOLS package includes the C source code so you can freely modify the routines to take advantage of your applications full potential. The routines may also be used as a guide to program other I/O boards! C-TOOLS also includes examples and software routines for:

THERMOCOUPLE LINEARIZATION

Thermocouple measurements must be linearized and corrected for cold juction error. C-TOOLS includes routines to accomplish that for thermocouple types S,R,E,J,K & T.

PID CONTROL

A complete PID control loop from analog acquisition, through calculation to analog output is included.

FOURIER ANALYSIS

An FFT routine which can be integrated into your application for power spectrum analysis, vibration monitoring or other analytical purposes

EXAMPLE PROGRAMS

Program examples for exch I/O boards written in C are included with C-TOOLS. Eaxmple programs cover most every mode on each I/O board, combining some modes into a single example where it makes sense to do so.

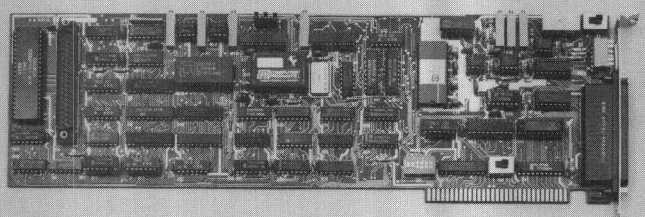
In addition, a complete, clear, user's manual includes explainations of every mode and how to integrate the modes into your C programs. Libraries of real-time graphics are available separately.

COUNTER			
CIO-CTR10	10 Channel, 16 Bit Counter/Timer (9513), 32 Digital	$239	16
CIO-CTR05	5 Channel, 16 Bit Counter/Timer (9513), 16 Digital	149	17
DIGITAL I/O			
CIO-DIO24	24 Digital I/O TTL Level	$ 59	19
CIO-DIO24H	24 Digital I/O High drive inputs & outputs	69	19
CIO-DIO48	48 Digital as 24 Digital I/O TTL Level, 24 Digital Output High Drive	115	18
CIO-DIO96	96 Digital I/O TTL Level	159	20
SCREW TERMINALS			
CIO-TERMINAL	16" X 4" Universal Screw Terminal with Prototype Area & Circuirty	$99	22
CIO-TERM100	16" X 4" Screw Terminal for CIO-DIO96. 100 Terminals	149	22
CIO-MINITERM	4" X 4" Universal Screw Terminal	49	23
CIO-SPADE50	16" X 4" Universal Screw Terminal with Spade Lug Terminals	99	22
CABLES			
BP-37	Backplate with 37 Pin Male Connector & Cable for CIO boards.	$ 25	23
C37FF-2	2' 37 Conductor Ribbon Cable, Female Connectors Each End	25	23
C37FF-#	Custom Length 37 Conductor Cable. Price/Foot Over C37FF-2	3	23
DFCON-37	Connector kit, 37 crimp pins, D connector & shell	15	23
DFCON-25	Connector kit, 25 crimp pins, D connector & shell	15	23
C37FFS-5	5' 37 Conductor Cable, Shielded Cable, Molded Female Connectors	30	23
C37FFS-10	10' 37 Conductor Cable, Shielded Cable, Molded Female Connectors	40	23
C-MUXAD16-10	10' 37 Cond., Shielded. CIO-AD16 to 1st CIO-MUX only.	40	13
C50FF-2	2' 50 Conductor Ribbon Cable, Female Connectors Each End	25	23
C50FF-#	Custom Length 50 Conductor Cable, Price/Foot Over C50FF-2	3	23
CMOLEX-10	10' 2 Conductor optional power cable for use with the MUX32 & MUX16	15	13
SOFTWARE			
LT-NB	LabTech Notebook Data Acquisition & Control Software	$ 995	26
CONTROL EG	Low Speed Control and Graphic Display	495	27
SNAP-SHOT	Storage Oscilloscope Data Acquistion and Analysis	495	28
SNAP-STREAM	High Speed A/D acquire and transfer direct to disk	495	29
	If purchased on the same order with any other SNP product.	395	29
SNAP-SERIES 100	Snap-Shot , Snap-Calc & Snap-Print bundled together	995	29
SNAP-SERIES 200	Snap-Series 100 bundled with Snap-FFT & Snap-Filter	1,495	29
T-TOOLS	Turbo Pascal Tools & Examples for Compatible I/O Series Boards	95	30
C-TOOLS	Microsoft C and TURBO C I/O boards support including source code	125	30
MISC. SUPPLIES			
CIO-PG408	DC/DC Converter. 5V in +/-15V out for CIO-MUX	$ 30	13

Prices are U.S.A list prices exclusive of shipping, taxes and duties. Outside the U.S.A. distributor pricing prevails.

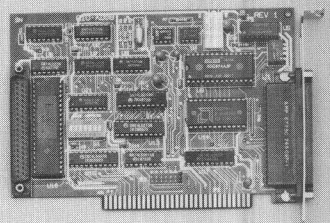
MANY OF THESE PRODUCTS ARE SUBJECT TO U.S.A. EXPORT REGULATIONS

ORDERING & TERMS



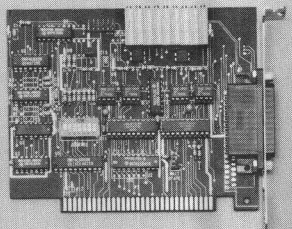
CIO-AD16/F $859 **SAVE $431**

MetraByte DAS-16/F ($1,165) + PIO-12 ($125) = $1,290



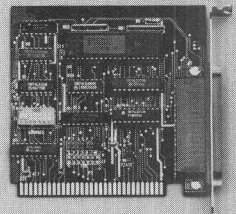
CIO-AD08 $299 **SAVE $251**

MetraByte DAS-8 ($425) + PIO-12 ($125) = $ 550



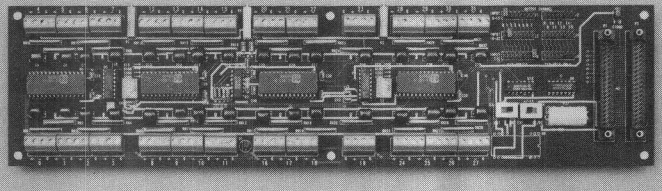
CIO-DAC02 $159 **SAVE $136**

MetraByte DAS-02 ($295)



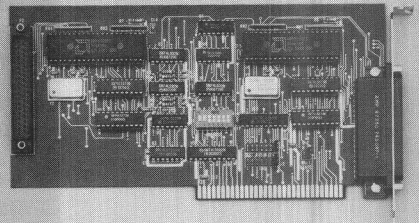
CIO-DIO24 $59 **SAVE $66**

MetraByte PIO-12 ($125)



CIO-MUX32 $349 **SAVE $449**

MetraByte EXP-16 * 2 ($399 * 2)



CIO-CTR10 $239 **SAVE $411**

MetraByte CTM-05 * 2 ($325 * 2) = $650

HOW TO ORDER

Orders are accepted by telephone, (508) 261-1123, FAX, (508) 261-1094 or written purchase order to 44 Wood Ave, Mansfield, MA, 02048. Business hours are from 8:00 A.M. to 6:00 P.M. Eastern Time.

TERMS

Purchases may be made by company purchase order, VISA, MasterCard, American Express, pre-payment or C.O.D. To establish credit terms please provide banking information and two trade references and allow a minimum of three days for credit approval. Credit terms are net 30 days. Same day shipment policy applies only to approved credit customers, C.O.D. and credit card purchases.

SHIPMENT

Orders are shipped F.O.B. Mansfield, MA via UPS ground, insured, unless otherwise specified at the time of order. Other services include UPS Blue, 2 days, UPS Red, overnight, Federal Express, overnight & no C.O.D. If you request, the shipping charge will be calulated and fixed at the time of order. Computer Boards, Inc. passes only the carrier's charge on to you and does not add any additional handling or other 'in-house' charges.

VOLUME DISCOUNTS & OEM PRICING

Volume discounts apply to quantities of a single item per shipment and will be applied automatically to your order. Customers interested in scheduled purchase orders and OEM pricing should call and ask for the sales manager.

Quality & Service

Three Year Product Warranty

Every Computer Boards, Inc. product is warranted against defects in materials or workmanship for a period of *THREE YEARS* from the date of delivery to the original purchaser. Any products found to be defective in material or workmanship will be repaired or replaced promptly

Lifetime *Harsh Environment Warranty*™

Any Computer Boards, Inc. product which is damaged due to misuse may be replaced for only 40% of the current list price. I/O boards face some harsh environments, some harsher than the boards are designed to withstand. When that happens, just return the board with an order for it's replacement at only 40% of the list price. Computer Boards does not need to profit from your misfortune.

The replacement discount from list price is based on the U.S.A. list prices in this catalog and is valid only for products purchased before the next catalog volume number is issued. If prices go down or costs go up in future catalogs, the replacement discount may be adjusted to reflect current conditions, but, you have our pledge that it will always be as fair as possible.

60 Day Money-Back Guaranty

Any Computer Boards, Inc. product may be returned within 60 days of purchase for a full refund of the price paid for the product being returned. If you are not satisfied, or chose the wrong product by mistake, you do not have to keep it. Please call for an RMA number first.

Orders Shipped Same Day

Any Computer Boards, Inc. product ordered before 2:00 pm Eastern time will be shipped that day unless a different ship date is given at the time of order. There is no extra charge for this service and, should we ever miss a promised ship date, Computer Boards will pay the freight.

Warranty & Repair in One Day

Any Computer Boards, Inc. product returned for repair under warranty will be repaired and shipped within 24 hours unless a Technical Support Engineer must contact and discuss the repair with you. Repairs are returned shipped by the same method as they are received. Please call for an RMA first.

Free Application Software & Manual

All Computer Boards, Inc. products are supplied with at least one free, menu driven application package and a complete technical users manual. No I/O board is so simple or so inexpensive that we feel a manual and software need not be included.

Free Technical Support

Computer Boards, Inc. was founded by ex-MetraByte data acquisition professionals who built a technical support group which was regarded the best in the industry. The tradition was carried with the founders to Computer Boards where our dedication to competent, responsive technical support both before and after the sale is being applied through high quality staffing and support tools such as expert systems and state of the art test equipment.

Computer Boards, INC
44 Wood Avenue, Mansfield, MA, 02048
Phone: (508) 261-1123 Fax: (508) 261-1094

BULK RATE
U.S.POSTAGE
PAID
PERMIT No. 43
MANSFIELD, MA
02048
BOUND
PRINTED
MATTER

Printed in the United States of America